

European Committee on Antimicrobial Susceptibility Testing

Breakpoint tables for interpretation of MICs and zone diameters

Version 12.0, valid from 2022-01-01

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Version 12.0, 2022-01-01	Changes (cells containing a change, a deletion or an addition) from v. 11.0 are marked yellow. Changed comments are underlined. Removed comments are shown in strikethrough font style.
Content	<ul style="list-style-type: none"> • Links to EUCAST Guidance Documents and Reading Guides added.
General	<ul style="list-style-type: none"> • Referral to EUCAST Reading Guides added to the methodology section at the top of each table. • QC recommendations for control of the inhibitor component of beta-lactam inhibitor combinations added to the methodology section at the top of table when relevant. • All link to rationale documents are to the start page for EUCAST rationale documents. • Links to rationale documents added for cefiderocol, imipenem-relebactam, meropenem-vaborbactam, delafloxacin, bedaquiline and delamanid. • Links to Guidance document on screening tests added to antimicrobial names for screening agents. • Terminology for screening tests updated according to the explanation in Note 9 in the Notes sheet. Changes in terminology only are not highlighted as changes.
Notes	<ul style="list-style-type: none"> • Note 9: New note on screening tests • Note 11: Explanation for breakpoints in brackets updated • Note 15: Reading examples added
Guidance	<ul style="list-style-type: none"> • Explanation for screening tests updated
Dosages	<p>Revised dosages</p> <ul style="list-style-type: none"> • Piperacillin-tazobactam (clarification regarding standard dosage) <p>Removed dosages</p> <ul style="list-style-type: none"> • Rifampicin high dosage <p>New comments</p> <ul style="list-style-type: none"> • Oxacillin • Cloxacillin • Dicloxacillin • Flucloxacillin • Clindamycin <p>Revised comments</p> <ul style="list-style-type: none"> • Piperacillin-tazobactam
Enterobacterales	<p>New breakpoints</p> <ul style="list-style-type: none"> • Meropenem-vaborbactam (zone diameter) <p>Revised breakpoints</p> <ul style="list-style-type: none"> • Colistin (brackets added, see Note 11 in the Notes sheet) <p>New ATUs</p> <ul style="list-style-type: none"> • Meropenem-vaborbactam (zone diameter) <p>New comments</p> <ul style="list-style-type: none"> • Carbapenems comment A • Miscellaneous agents comment 1 • Miscellaneous agents comment 3 <p>Revised comments</p> <ul style="list-style-type: none"> • Aminoglycosides comment 1/A

Version 12.0, 2022-01-01	Changes (cells containing a change, a deletion or an addition) from v. 11.0 are marked yellow. Changed comments are underlined. Removed comments are shown in strikethrough font style.
<i>Pseudomonas</i> spp.	<p>General</p> <ul style="list-style-type: none"> • Species information added for "meropenem (indications other than meningitis)" • Species information added for "meropenem (meningitis)" <p>New breakpoints</p> <ul style="list-style-type: none"> • Meropenem-vaborbactam (zone diameter) <p>Revised breakpoints</p> <ul style="list-style-type: none"> • Meropenem (zone diameter), separate breakpoints for <i>P. aeruginosa</i> and "Pseudomonas other than <i>P. aeruginosa</i>" • "Meropenem (meningitis)" (zone diameter) • Levofloxacin (MIC and zone diameter) • Colistin (brackets added, see Note 11 in the Notes sheet) <p>Removed ATU</p> <ul style="list-style-type: none"> • Colistin (MIC) <p>New comments</p> <ul style="list-style-type: none"> • Miscellaneous agents comment 2 <p>Revised comments</p> <ul style="list-style-type: none"> • Aminoglycosides comment 1/A
<i>Acinetobacter</i> spp.	<p>Revised breakpoints</p> <ul style="list-style-type: none"> • Colistin (brackets added, see Note 11 in the Notes sheet) <p>New comments</p> <ul style="list-style-type: none"> • Miscellaneous agents comment 2 <p>Revised comments</p> <ul style="list-style-type: none"> • Aminoglycosides comment 1/A

Version 12.0, 2022-01-01	Changes (cells containing a change, a deletion or an addition) from v. 11.0 are marked yellow. Changed comments are underlined. Removed comments are shown in strikethrough font style.
Staphylococcus spp.	<p>General</p> <ul style="list-style-type: none"> • Taxonomy information and recommendations for <i>S. saccharolyticus</i> updated • Species information on benzylpenicillin updated • Species information on "oxacillin (screen only)" updated • Species information on "cefoxitin (screen only)" updated (all three rows) • "Erythromycin (screen only)" added • "Tetracycline (screen only)" added • Reading instructions for benzylpenicillin clarified <p>Revised breakpoints</p> <ul style="list-style-type: none"> • Cefoxitin (screen only), <i>S. epidermidis</i> and <i>S. lugdunensis</i> • Delafloxacin (MIC), separate breakpoints for "community-acquired pneumonia" and "skin and skin structure infections" • Amikacin (MIC and zone diameter) • Gentamicin (MIC) • Tobramycin (MIC and zone diameter) • Azithromycin (MIC) • Clindamycin (MIC and zone diameter) • Tedizolid (zone diameter) • Rifampicin (MIC and zone diameter) <p>New ATUs</p> <ul style="list-style-type: none"> • Cefoxitin (screen only), <i>S. lugdunensis</i> • Tedizolid (zone diameter) <p>Revised ATUs</p> <ul style="list-style-type: none"> • Cefoxitin (screen only), <i>S. epidermidis</i> <p>Removed ATUs</p> <ul style="list-style-type: none"> • Amikacin (zone diameter) <p>New comments</p> <ul style="list-style-type: none"> • Miscellaneous agents comment 1 <p>Revised comments</p> <ul style="list-style-type: none"> • Penicillins comment 2/C • Penicillins comment B • Penicillins comment E • Cephalosporins comment 5/C • Fluoroquinolones comment C • Aminoglycosides comment 1/A • Macrolides comment 1/A • Tetracyclines comment 1/A
Streptococcus groups A, B, C and G	<p>General</p> <ul style="list-style-type: none"> • "Tetracycline (screen only)" added <p>Revised breakpoints</p> <ul style="list-style-type: none"> • Rifampicin (MIC and zone diameter) <p>New comments</p> <ul style="list-style-type: none"> • Miscellaneous agents comment 1 <p>Revised comments</p> <ul style="list-style-type: none"> • Fluoroquinolones comment C • Tetracyclines comment 1/A

Version 12.0, 2022-01-01	Changes (cells containing a change, a deletion or an addition) from v. 11.0 are marked yellow. Changed comments are underlined. Removed comments are shown in strikethrough font style.
<i>Streptococcus pneumoniae</i>	General <ul style="list-style-type: none"> • "Tetracycline (screen only)" added • New format for flow chart • Several updates in flow chart (including a change in the lower oxacillin screening breakpoint from <8 to <9 mm for specific agents, addition of imipenem and meropenem to the lower oxacillin screening breakpoint and changed recommendations for MIC determination in meningitis) Revised breakpoints <ul style="list-style-type: none"> • "Ampicillin (indications other than meningitis)" (MIC and zone diameter) • Rifampicin (MIC and zone diameter) Revised comments <ul style="list-style-type: none"> • Penicillins comment B • Cephalosporins comment B • Carbapenems comment C • Fluoroquinolones comment B • Tetracyclines comment 1/A • Miscellaneous agents comment 1 Removed comments <ul style="list-style-type: none"> • Penicillins comment D
Viridans group streptococci	Revised comments <ul style="list-style-type: none"> • Penicillins comment 1/A
<i>Haemophilus influenzae</i>	General <ul style="list-style-type: none"> • Separate rows for "cefotaxime (indications other than meningitis)" and cefotaxime (meningitis)" • Separate rows for "ceftriaxone (indications other than meningitis)" and "ceftriaxone (meningitis)" • New format for flow chart (no changes in the recommendations) Revised breakpoints <ul style="list-style-type: none"> • Tetracycline (MIC and zone diameter) New comments <ul style="list-style-type: none"> • Cephalosporins comment D Revised comments <ul style="list-style-type: none"> • Penicillins comment F • Fluoroquinolones comment B • Tetracyclines comment 1/A Removed comments <ul style="list-style-type: none"> • Cephalosporins comment 4 (information moved to antimicrobial name)
<i>Moraxella catarrhalis</i>	Revised breakpoints <ul style="list-style-type: none"> • Tetracycline (MIC and zone diameter) Revised comments <ul style="list-style-type: none"> • Fluoroquinolones comment B • Tetracyclines comment 1/A

Version 12.0, 2022-01-01	Changes (cells containing a change, a deletion or an addition) from v. 11.0 are marked yellow. Changed comments are underlined. Removed comments are shown in strikethrough font style.
<i>Neisseria meningitidis</i>	<p>General</p> <ul style="list-style-type: none"> • "(All indications)" added for benzylpenicillin • "(All indications)" added for cefotaxime • "(All indications including prophylaxis)" added for ceftriaxone • "(All indications)" added for meropenem • "Meropenem (indications other than meningitis)" removed • "(Prophylaxis only)" added for ciprofloxacin • "(Prophylaxis only)" added for minocycline • "(Screen only)" added for tetracycline • "(Prophylaxis only)" added for rifampicin <p>Revised comments</p> <ul style="list-style-type: none"> • Carbapenems comment 2 • Carbapenems comment 3 <p>Removed comments</p> <ul style="list-style-type: none"> • Fluoroquinolones comment 1 (information moved to antimicrobial name) • Miscellaneous agents comment 2 (information moved to antimicrobial name)
Anaerobic bacteria	<ul style="list-style-type: none"> • New table with species-specific breakpoints which replaces the old tables for Gram-negative and Gram-positive anaerobes and for <i>C. difficile</i>. For species not listed, see EUCAST Guidance Document on how to test and interpret results when there are no breakpoints.
<i>Listeria monocytogenes</i>	<p>General</p> <ul style="list-style-type: none"> • "(All indications)" added for "ampicillin iv" • "(All indications)" added for meropenem • "(Indications other than meningitis)" added for erythromycin • "(All indications)" added for trimethoprim-sulfamethoxazole
<i>Pasteurella multocida</i>	<p>Revised comments</p> <ul style="list-style-type: none"> • Fluoroquinolones comment B
<i>Kingella kingae</i>	<p>Revised comments</p> <ul style="list-style-type: none"> • Tetracyclines comment 1/A
<i>Vibrio spp.</i>	<ul style="list-style-type: none"> • New table
<i>Burkholderia pseudomallei</i>	<ul style="list-style-type: none"> • Screening breakpoint for tetracycline and tetracycline comment 1 revised to comply with the new terminology for screening tests. No change in reporting of results.
Topical agents	<p>General</p> <ul style="list-style-type: none"> • Information on how to report results for topical agents added <p>Revised cut-off values</p> <ul style="list-style-type: none"> • <i>P. aeruginosa</i> and levofloxacin (zone diameter)
PK-PD breakpoints	<p>New breakpoints</p> <ul style="list-style-type: none"> • Temocillin <p>Revised breakpoints</p> <ul style="list-style-type: none"> • Oritavancin (changed to IE) <p>Removed comments</p> <ul style="list-style-type: none"> • Glycopeptides and lipoglycopeptides comment 2

European Committee on Antimicrobial Susceptibility Testing

Breakpoint tables for interpretation of MICs and zone diameters

Version 12.0, valid from 2022-01-01

Notes

1. The EUCAST clinical breakpoint tables contain clinical MIC breakpoints (determined or revised during 2002-2021) and their inhibition zone diameter correlates. The EUCAST breakpoint table version 12.0 includes corrected typographical errors, clarifications, breakpoints for new agents and/or organisms, revised MIC breakpoints and revised and new zone diameter breakpoints. Changes are best seen on screen or on a colour printout since cells containing a change are yellow. New or revised comments are underlined. Removed comments are shown in strikethrough font style.
2. PK-PD (Non-species related) breakpoints are listed separately.
3. Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
4. Antimicrobial agent names in blue are linked to EUCAST rationale documents. MIC and zone diameter breakpoints in blue are linked to the search page of the EUCAST MIC and zone diameter distribution database.
5. The document is released as an Excel file suitable for viewing on screen and as an Acrobat pdf file suitable for printing. To utilize all functions in the Excel file, use Microsoft original programs only. The Excel file enables users to alter the list of agents to suit the local range of agents tested. The content of single cells cannot be changed. Hide lines by right-clicking on the line number and choose "hide". Hide columns by right-clicking on the column letter and choose "hide".
6. EUCAST breakpoints are used to categorise results into three susceptibility categories:
S - Susceptible, standard dosing regimen: A microorganism is categorised as *Susceptible, standard dosing regimen*, when there is a high likelihood of therapeutic success using a standard dosing regimen of the agent.
I - Susceptible, increased exposure: A microorganism is categorised as *Susceptible, increased exposure* * when there is a high likelihood of therapeutic success because exposure to the agent is increased by adjusting the dosing regimen or by its concentration at the site of infection.
R - Resistant: A microorganism is categorised as *Resistant* when there is a high likelihood of therapeutic failure even when there is increased exposure.
*Exposure is a function of how the mode of administration, dose, dosing interval, infusion time, as well as distribution and excretion of the antimicrobial agent will influence the infecting organism at the site of infection.
7. "-" indicates that susceptibility testing is not recommended as the species is a poor target for therapy with the agent. Isolates may be reported as R without prior testing.
8. "IE" indicates that there is insufficient evidence that the organism or group is a good target for therapy with the agent. An MIC with a comment but without an accompanying S, I or R categorisation may be reported.
9. A screening test uses one agent to predict resistance or susceptibility to one or more antimicrobial agents in the same class. The screening test is often more sensitive and/or robust than testing individual agents. Using a screening test will often reduce the number of tests needed in primary susceptibility testing since it will predict susceptibility and/or resistance to several agents. Guidance on how to act on the screening test result is described in the Note related to each specific screening test.
Negative screening test: MIC below or equal to or zone diameter above or equal to the susceptible breakpoint for the screening agent. No resistance mechanisms to the antimicrobial class detected.
Positive screening test: MIC above or zone diameter below the resistant breakpoint for the screening agent. Resistance mechanisms to the antimicrobial class detected.

Notes

10. For an agent and a species, the ECOFF (epidemiological cut-off) value is the highest MIC (or the smallest inhibition zone diameter) for organisms devoid of phenotypically detectable acquired resistance mechanisms. Breakpoints in brackets are based on ECOFF values for relevant species. They are used to distinguish between organisms with and without acquired resistance mechanisms. ECOFFs do not predict clinical susceptibility but in some situations and/or when the agent is combined with another active agent, therapy may be considered.

11. Breakpoints in brackets distinguish between isolates without and with phenotypically detectable resistance mechanisms. They are based on ECOFFs but since they may serve more than one species, the value may represent a best fit. For these agents, clinical evidence as monotherapy is usually lacking but for a specific indication or in combination with another active agent or measure they may still be used. Isolates with resistance can be reported R (resistant). If S or I are reported, there must be a comment to explain the caveat mentioned above.

12. An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

13. For some organism-agent combinations, results may be in an area where the interpretation is uncertain. EUCAST has designated this an Area of Technical Uncertainty (ATU). It corresponds to an MIC value and/or zone diameter interval where the categorisation is doubtful. See separate page for more information on ATU and how to deal with results in the ATU.

14. In order to simplify the EUCAST tables, the "Susceptible, increased exposure" (I category) is not listed. It is interpreted as values between the S and the R breakpoints. For example, for MIC breakpoints listed as $S \leq 1$ mg/L and $R > 8$ mg/L, the I category is 2-8 (technically $>1-8$) mg/L, and for zone diameter breakpoints listed as $S \geq 22$ mm and $R < 18$ mm, the I category is 18-21 mm.

15. For *Escherichia coli* with fosfomycin, *Staphylococcus aureus* with benzylpenicillin, enterococci with vancomycin, *Haemophilus influenzae* with beta-lactam agents, *Stenotrophomonas maltophilia*, *Aeromonas* spp., *Achromobacter xylosoxidans* and *Burkholderia pseudomallei* with trimethoprim-sulfamethoxazole, and for anaerobic bacteria in general, it is crucial to follow specific reading instructions for correct interpretation of the disk diffusion test. For these, pictures with reading examples are included at the end of the corresponding breakpoint table. For general and other specific reading instructions, please refer to the EUCAST Reading Guide.

16. With a few exceptions, EUCAST recommends the use of the broth microdilution reference method as described by the International Standards Organisation for MIC determination of non-fastidious organisms. For fastidious organisms, EUCAST recommends the use of the same methodology but with the use of MH-F broth (Mueller-Hinton broth with lysed horse blood and beta-NAD), see EUCAST media preparation file at www.eucast.org. There are a number of commercially available surrogate methods, for which it is the responsibility of the manufacturer to guarantee the accuracy of the system and the responsibility of the user to quality control the results.

17. By international convention MIC dilution series are based on twofold dilutions up and down from 1 mg/L. At dilutions below 0.25 mg/L, this leads to concentrations with multiple decimal places. To avoid having to use these in tables and documents, EUCAST has decided to use the following format (in bold): 0.125→**0.125**, 0.0625→**0.06**, 0.03125→**0.03**, 0.015625→**0.016**, 0.0078125→**0.008**, 0.00390625→**0.004** and 0.001953125→**0.002** mg/L.

18. Definitions of "uncomplicated UTI" and "Infections originating from the urinary tract" used with EUCAST breakpoints:

Uncomplicated UTI: acute, sporadic or recurrent lower urinary tract infections (uncomplicated cystitis) in patients with no known relevant anatomical or functional abnormalities within the urinary tract or comorbidities.

Infections originating from the urinary tract: Infections originating from, but not confined to, the urinary tract, including acute pyelonephritis and bloodstream infections.

Abbreviations

NA = Not Applicable

IP = In Preparation

Guidance on reading EUCAST Breakpoint Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

MIC determination (broth microdilution according to ISO standard 20776-1)
Medium:
Inoculum:
Incubation:
Reading:
Quality control:

EUCAST methodology and quality control for MIC determination

Disk diffusion (EUCAST standardised disk diffusion method)
Medium:
Inoculum:
Incubation:
Reading:
Quality control:

EUCAST methodology and quality control for disk diffusion

An arbitrary "off scale" breakpoint which categorises wild-type organisms as "Susceptible, increased exposure (I)".

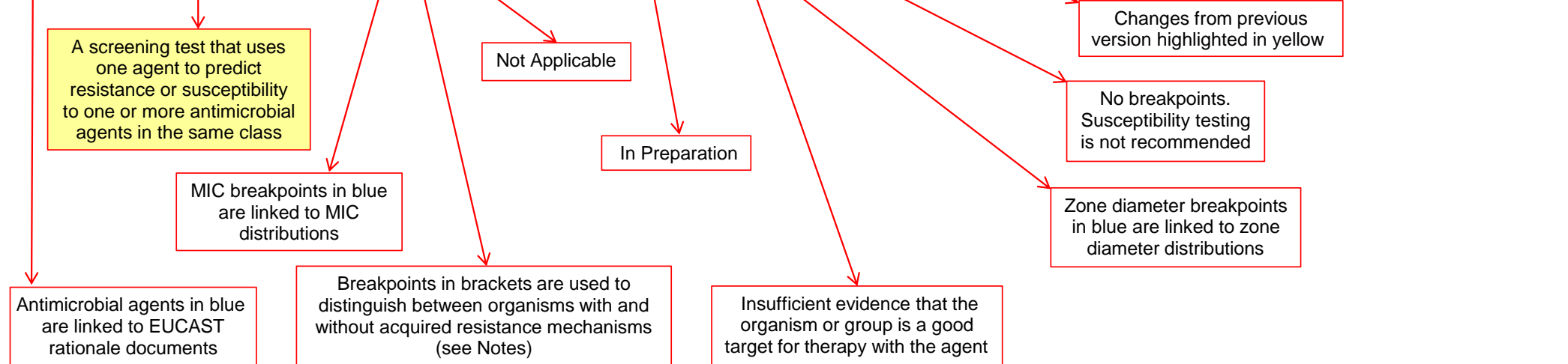
Breakpoints with a species name apply only to that particular species (in this example *S. aureus*)

The I category is not listed but is interpreted as the values between the S and the R breakpoints. If the S and R breakpoints are the same value there is no I category.

Agent A: No I category
 Agent B: I category: 4 mg/L, 23-25 mm
 Agent H: I category: 1-2 mg/L, 24-29 mm

Area of Technical Uncertainty
See specific information on how to handle technical uncertainty in antimicrobial susceptibility testing.

Antimicrobial agent	MIC breakpoint (mg/L)			Disk content (µg)	Zone diameter breakpoint (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Antimicrobial agent A	1 ¹	1 ¹		X	20 ^A	20 ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. Notes that are general comments and/or relating to MIC breakpoints. 2. New comment Removed comment A. Comment on disk diffusion
Antimicrobial agent B	2 ²	4		Y	26	23		
Antimicrobial agent C	0.001	8		X	50	18		
Antimicrobial agent D, <i>S. aureus</i>	IE	IE			IE	IE		
Antimicrobial agent E	-	-			-	-		
Antimicrobial agent F	IP	IP			IP	IP		
Antimicrobial agent G (screen only)	NA	NA		Y	25	25		
Antimicrobial agent H	0.5	2		Z	30	24		
Antimicrobial agent I	(8) ¹	(8) ¹		30	(18) ^A	(18) ^A		



Dosages

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

EUCAST breakpoints are based on the following dosages (see section 8 in Rationale Documents). Alternative dosing regimens may result in equivalent exposure. The table should not be considered a guidance for dosing in clinical practice, and does not replace specific local, national, or regional dosing guidelines. However, if national practices significantly differ from those listed below, EUCAST breakpoints may not be valid. Situations where less antibiotic is given as standard or high dose should be discussed locally or regionally.

Uncomplicated UTI: acute, sporadic or recurrent lower urinary tract infections (uncomplicated cystitis) in patients with no known relevant anatomical or functional abnormalities within the urinary tract or comorbidities.

Penicillins	Standard dosage	High dosage	Uncomplicated UTI	Special situations
Benzylpenicillin	0.6 g (1 MU) x 4 iv	1.2 g (2 MU) x 4-6 iv		<p>Meningitis caused by <i>S. pneumoniae</i>: For a dose of 2.4 g (4 MU) x 6 iv, isolates with MIC ≤ 0.06 mg/L are susceptible.</p> <p>Pneumonia caused by <i>S. pneumoniae</i>: breakpoints are related to dosage: For a dose of 1.2 g (2 MU) x 4 iv, isolates with MIC ≤ 0.5 mg/L are susceptible. For a dose of 2.4 (4 MU) g x 4 iv or 1.2 g (2 MU) x 6 iv, isolates with MIC ≤ 1 mg/L are susceptible. For a dose of 2.4 g (4 MU) x 6 iv, isolates with MIC ≤ 2 mg/L are susceptible.</p>
Ampicillin	2 g x 3 iv	2 g x 4 iv		Meningitis: 2 g x 6 iv
Ampicillin-sulbactam	(2 g ampicillin + 1 g sulbactam) x 3 iv	(2 g ampicillin + 1 g sulbactam) x 4 iv		
Amoxicillin iv	1 g x 3-4 iv	2 g x 6 iv		Meningitis: 2 g x 6 iv
Amoxicillin oral	0.5 g x 3 oral	0.75-1 g x 3 oral	0.5 g x 3 oral	
Amoxicillin-clavulanic acid iv	(1 g amoxicillin + 0.2 g clavulanic acid) x 3-4 iv	(2 g amoxicillin + 0.2 g clavulanic acid) x 3 iv		
Amoxicillin-clavulanic acid oral	(0.5 g amoxicillin + 0.125 g clavulanic acid) x 3 oral	(0.875 g amoxicillin + 0.125 g clavulanic acid) x 3 oral	(0.5 g amoxicillin + 0.125 g clavulanic acid) x 3 oral	Amoxicillin-clavulanic acid has separate breakpoints for systemic infections and uncomplicated UTI. When amoxicillin-clavulanic acid is reported for uncomplicated UTI, the report must make clear that the susceptibility category is only valid for uncomplicated UTI.
Piperacillin	4 g x 4 iv	4 g x 4 iv by extended 3-hour infusion		High dosage for more serious infections.
Piperacillin-tazobactam	(4 g piperacillin + 0.5 g tazobactam) x 4 iv 30-minute infusion or x 3 iv by extended 4-hour infusion	(4 g piperacillin + 0.5 g tazobactam) x 4 iv by extended 3-hour infusion		A lower dosage of (4 g piperacillin + 0.5 g tazobactam) x 3 iv, 30-minute infusion, is adequate for some infections such as complicated UTI, intraabdominal infections and diabetic foot infections, but not for infections caused by isolates resistant to third-generation cephalosporins.
Ticarcillin	3 g x 4 iv	3 g x 6 iv		
Ticarcillin-clavulanic acid	(3 g ticarcillin + 0.1-0.2 g clavulanic acid) x 4 iv	(3 g ticarcillin + 0.1 g clavulanic acid) x 6 iv		
Temocillin	2 g x 2 iv	2 g x 3 iv		The 2 g x 2 iv dose has been used in the treatment of uncomplicated UTI caused by bacteria with beta-lactam resistance mechanisms.
Phenoxymethylpenicillin	0.5-2 g x 3-4 oral depending on species and/or infection type	None		
Oxacillin	1 g x 4 iv	1 g x 6 iv		The high exposure dosing regimen pertains to the severity of the infection or drug exposure at the site of infection.
Cloxacillin	0.5 g x 4 oral or 1 g x 4 iv	1 g x 4 oral or 2 g x 6 iv		The high exposure dosing regimen pertains to the severity of the infection or drug exposure at the site of infection.
Dicloxacillin	0.5-1 g x 4 oral or 1 g x 4 iv	2 g x 4 oral or 2 g x 6 iv		The high exposure dosing regimen pertains to the severity of the infection or drug exposure at the site of infection.
Flucloxacillin	1 g x 3 oral or 2 g x 4 iv (or 1 g x 6 iv)	1 g x 4 oral or 2 g x 6 iv		The high exposure dosing regimen pertains to the severity of the infection or drug exposure at the site of infection.
Mecillinam oral (pivmecillinam)	None	None	0.2-0.4 g x 3 oral	

Dosages

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Cephalosporins	Standard dosage	High dosage	Uncomplicated UTI	Special situations
Cefaclor	0.25-0.5 g x 3 oral depending on species and/or infection type	1 g x 3 oral		<i>Staphylococcus</i> spp.: Minimum dose 0.5 g x 3 oral
Cefadroxil	0.5-1 g x 2 oral	None	0.5-1 g x 2 oral	
Cefalexin	0.25-1 g x 2-3 oral	None	0.25-1 g x 2-3 oral	
Cefazolin	1 g x 3 iv	2 g x 3 iv		
Cefepime	1 g x 3 iv or 2 g x 2 iv	2 g x 3 iv		
Cefiderocol	2 g x 3 iv over 3 hours	None		
Cefixime	0.2-0.4 g x 2 oral	None	0.2-0.4 g x 2 oral	Uncomplicated gonorrhoea: 0.4 g oral as a single dose
Cefotaxime	1 g x 3 iv	2 g x 3 iv		Meningitis: 2 g x 4 iv <i>S. aureus</i> : High dose only
Cefpodoxime	0.1-0.2 g x 2 oral	None	0.1-0.2 g x 2 oral	
Ceftaroline	0.6 g x 2 iv over 1 hour	0.6 g x 3 iv over 2 hours		<i>S. aureus</i> in complicated skin and skin structure infections: There is some PK-PD evidence to suggest that isolates with MICs of 4 mg/L could be treated with high dose.
Ceftazidime	1 g x 3 iv	2 g x 3 iv or 1 g x 6 iv		
Ceftazidime-avibactam	(2 g ceftazidime + 0.5 g avibactam) x 3 iv over 2 hours			
Ceftibuten	0.4 g x 1 oral	None		
Ceftobiprole	0.5 g x 3 iv over 2 hours	None		
Ceftolozane-tazobactam (intra-abdominal infections and UTI)	(1 g ceftolozane + 0.5 g tazobactam) x 3 iv over 1 hour	None		
Ceftolozane-tazobactam (hospital acquired pneumonia, including ventilator associated pneumonia)	(2 g ceftolozane + 1 g tazobactam) x 3 iv over 1 hour	None		
Ceftriaxone	2 g x 1 iv	2 g x 2 iv or 4 g x 1 iv		Meningitis: 2 g x 2 iv or 4 g x 1 iv <i>S. aureus</i> : High dose only Uncomplicated gonorrhoea: 0.5-1 g im as a single dose
Cefuroxime iv	0.75 g x 3 iv	1.5 g x 3 iv		
Cefuroxime oral	0.25 g x 2 oral	0.5 g x 2 oral	0.25 g x 2 oral	

Carbapenems	Standard dosage	High dosage	Uncomplicated UTI	Special situations
Doripenem	0.5 g x 3 iv over 1 hour	1 g x 3 iv over 1 hour		HAP/VAP* due to non-fermenting Gram-negative pathogens (such as <i>Pseudomonas</i> spp. and <i>Acinetobacter</i> spp.) should be treated with 1 g x 3 iv over 4 hours.
Ertapenem	1 g x 1 iv over 30 minutes	None		
Imipenem	0.5 g x 4 iv over 30 minutes	1 g x 4 iv over 30 minutes		
Imipenem-relebactam	(0.5 g imipenem + 0.25 g relebactam) x 4 iv over 30 minutes	None		
Meropenem	1 g x 3 iv over 30 minutes	2 g x 3 iv over 3 hours		Meningitis: 2 g x 3 iv over 30 minutes (or 3 hours)
Meropenem-vaborbactam	(2 g meropenem + 2 g vaborbactam) x 3 iv over 3 hours			

* HAP/VAP = hospital-acquired pneumonia/ventilator-associated pneumonia

Dosages

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Monobactams	Standard dosage	High dosage	Uncomplicated UTI	Special situations
Aztreonam	1 g x 3 iv	2 g x 4 iv		

Fluoroquinolones	Standard dosage	High dosage	Uncomplicated UTI	Special situations
Ciprofloxacin	0.5 g x 2 oral or 0.4 g x 2 iv	0.75 g x 2 oral or 0.4 g x 3 iv		
Delafloxacin	0.45 g x 2 oral or 0.3 g x 2 iv	None		
Levofloxacin	0.5 g x 1 oral or 0.5 g x 1 iv	0.5 g x 2 oral or 0.5 g x 2 iv		
Moxifloxacin	0.4 g x 1 oral or 0.4 g x 1 iv	None		
Norfloxacin	None	None	0.4 g x 2 oral	
Ofloxacin	0.2 g x 2 oral or 0.2 g x 2 iv	0.4 g x 2 oral or 0.4 g x 2 iv		

Aminoglycosides	Standard dosage	High dosage	Uncomplicated UTI	Special situations
Amikacin	25-30 mg/kg x 1 iv	None		
Gentamicin	6-7 mg/kg x 1 iv	None		
Netilmicin	Under review	Under review		
Tobramycin	6-7 mg/kg x 1 iv	None		

Glycopeptides and lipoglycopeptides	Standard dosage	High dosage	Uncomplicated UTI	Special situations
Dalbavancin	1 g x 1 iv over 30 minutes on day 1 If needed, 0.5 g x 1 iv over 30 minutes on day 8	None		
Oritavancin	1.2 g x 1 (single dose) iv over 3 hours	None		
Teicoplanin	0.4 g x 1 iv	0.8 g x 1 iv		
Telavancin	10 mg/kg x 1 iv over 1 hour	None		
Vancomycin	0.5 g x 4 iv or 1 g x 2 iv or 2 g x 1 by continuous infusion	None		Based on body weight. Therapeutic drug monitoring should guide dosing.

Macrolides, lincosamides and streptogramins	Standard dosage	High dosage	Uncomplicated UTI	Special situations
Azithromycin	0.5 g x 1 oral or 0.5 g x 1 iv	None		Uncomplicated gonorrhoea: 2 g oral as a single dose
Clarithromycin	0.25 g x 2 oral	0.5 g x 2 oral		In some countries clarithromycin is available for intravenous administration at a dose of 0.5 g x 2, principally for treating pneumonia.
Erythromycin	0.5 g x 2-4 oral or 0.5 g x 2-4 iv	1 g x 4 oral or 1 g x 4 iv		
Roxithromycin	0.15 g x 2 oral	None		
Telithromycin	0.8 g x 1 oral	None		
Clindamycin	0.3 g x 2 oral or 0.6 g x 3 iv	0.3 g x 4 oral or 0.9 g x 3 iv		The high exposure dosing regimen pertains to the severity of the infection or drug exposure at the site of infection.
Quinupristin-dalfopristin	7.5 mg/kg x 2 iv	7.5 mg/kg x 3 iv		

Dosages

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Tetracyclines	Standard dosage	High dosage	Uncomplicated UTI	Special situations
Doxycycline	0.1 g x 1 oral	0.2 g x 1 oral		
Eravacycline	1 mg/kg x 2 iv	None		
Minocycline	0.1 g x 2 oral	None		
Tetracycline	0.25 g x 4 oral	0.5 g x 4 oral		
Tigecycline	0.1 g loading dose followed by 50 mg x 2 iv	None		

Oxazolidinones	Standard dosage	High dosage	Uncomplicated UTI	Special situations
Linezolid	0.6 g x 2 oral or 0.6 g x 2 iv	None		
Tedizolid	0.2 g x 1 oral or 0.2 g x 1 iv	None		

Miscellaneous agents	Standard dosage	High dosage	Uncomplicated UTI	Special situations
Chloramphenicol	1 g x 4 oral or 1 g x 4 iv	2 g x 4 oral or 2 g x 4 iv		For chloramphenicol treatment of meningitis always use intravenous high dose.
Colistin	4.5 MU x 2 iv with a loading dose of 9 MU	None		
Daptomycin (cSSTI** without concurrent <i>S. aureus</i> bacteraemia)	4 mg/kg x 1 iv	None		
Daptomycin (cSSTI** with concurrent <i>S. aureus</i> bacteraemia; right-sided infective endocarditis due to <i>S. aureus</i>)	6 mg/kg x 1 iv	None		Enterococcal bloodstream infection and endocarditis , see https://www.eucast.org/eucastguidancedocuments .
Fidaxomicin	0.2 g x 2 oral	None		
Fosfomycin iv	4 g x 3 iv	8 g x 3 iv		
Fosfomycin oral	None	None	3 g x 1 oral as a single dose	
Fusidic acid	0.5 g x 2 oral or 0.5 g x 2 iv	0.5 g x 3 oral or 0.5 g x 3 iv		
Lefamulin	0.15 g x 2 iv or 0.6 g x 2 oral	None		
Metronidazole	0.4 g x 3 oral or 0.4 g x 3 iv	0.5 g x 3 oral or 0.5 g x 3 iv		
Nitrofurantoin	None	None	50-100 mg x 3-4 oral	Dosing is dependent on drug formulation.
Nitroxoline	None	None	0.25 g x 3 oral	
Rifampicin	0.6 g x 1 oral or 0.6 g x 1 iv			
Spectinomycin	2 g x 1 im	None		
Trimethoprim	None	None	0.16 g x 2 oral	
Trimethoprim-sulfamethoxazole	(0.16 g trimethoprim + 0.8 g sulfamethoxazole) x 2 oral or (0.16 g trimethoprim + 0.8 g sulfamethoxazole) x 2 iv	(0.24 g trimethoprim + 1.2 g sulfamethoxazole) x 2 oral or (0.24 g trimethoprim + 1.2 g sulfamethoxazole) x 2 iv	(0.16 g trimethoprim + 0.8 g sulfamethoxazole) x 2 oral	

** cSSTI = complicated skin and skin structure infection

European Committee on Antimicrobial Susceptibility Testing

Breakpoint tables for interpretation of MICs and zone diameters

Version 12.0, valid from 2022-01-01

How to handle technical uncertainty in antimicrobial susceptibility testing

All measurements are affected by random variation and some by systematic variation. Systematic variation can normally be avoided and random variation should be reduced as much as possible. Antimicrobial susceptibility testing (AST), irrespective of method, is no exception.

EUCAST strives to minimise variation by providing standardised methods for MIC determination and disk diffusion and by avoiding setting breakpoints which seriously affect the reproducibility of AST. Variation in AST can be further reduced by setting more stringent standards for manufacturers of AST material (broth, agar, antimicrobial disks) and criteria for quality control of manufacturing processes and laboratory practices.

It is tempting to think that generating an MIC value will solve all problems. However, MIC measurements also have variation and a single value is not automatically accurate. Even when using the reference method, MICs might vary between days and technicians. Under the best of circumstances, an MIC of 1.0 mg/L should be considered as a value between 0.5 and 2.0 mg/L, although the probability of getting any one of these three values is not equal and will vary among strains and antimicrobial agents. Not infrequently, EUCAST discovers problems with commercial testing systems including quality of disks and media for disk diffusion, commercial panels for broth microdilution tests, gradient tests and semi-automated AST devices. Some of these affect accuracy (poorly calibrated concentration series) and others precision (poor general quality,

Although AST is straightforward for most agents and species, there are problematic situations even when testing is performed to a high standard. It is important to warn laboratories about these and the uncertainty of susceptibility categorisation. Analysis of EUCAST data (readily available at http://www.eucast.org/ast_of_bacteria/calibration_and_validation/) that have been generated over the years has identified such situations, named by EUCAST “**Area of Technical Uncertainty (ATU)**”. The ATUs are **warnings to laboratory staff** that there is an uncertainty that needs to be addressed before reporting AST results to clinical colleagues. The ATU is not a susceptibility category and does not prevent the laboratory from interpreting the susceptibility test result.

Below are alternatives for how the ATUs can be dealt with by the laboratory. Which of these actions are chosen will depend on the situation. The type of sample (blood culture vs. urine culture), the number of alternative agents available, the severity of the disease, whether or not a consultation with clinical colleagues is feasible, will

- **Repeat the test**

To ONLY repeat the test is relevant if there is reason to suspect a technical problem in the primary AST. To repeat the test while confirming the result with another test is good laboratory practice. If an MIC test is performed, the chances are that this result may also end up in the ATU. If so, a primary test and an alternative test may both point to a result and an interpretation in the ATU. In this case, interpret the result according to the breakpoints and report.

- **Use an alternative test (perform an MIC or a genotypic test)**

This may be relevant if the susceptibility report otherwise leaves only few therapeutic alternatives. If the organism is multi-resistant, perform an MIC determination for several antibiotics, possibly extending the AST to include new beta-lactam inhibitor combinations, ceftiderocol and colistin for Gram-negative bacteria. Sometimes it may be necessary to perform genotypic or phenotypic characterisation of the resistance mechanism to obtain more information, some of which may be of importance for epidemiological decisions. When performing an MIC, this result may end up in the ATU. In this case, interpret the result according to the breakpoints and report.

How to handle technical uncertainty in antimicrobial susceptibility testing

- **Downgrade the susceptibility category**

If there are other therapeutic alternatives in the AST report, it is permissible to downgrade the result (from S to I, or from I to R or from S to R). However, a comment should be included and the isolate saved for further testing.

- **Include the uncertainty as part of the report**

It is common practice in many other laboratory settings to include information on the uncertainty of the reported result. This can be dealt with in several alternative ways:

- Report results in the ATU as "uncertain". This can be achieved by leaving the interpretation "blank + a comment".
- Develop the LIS system to deliver an asterisk or Note (instead of an S, I or R) which refers to a comment explaining the uncertainty.
- Categorise the result according to the breakpoints but include information about the technical difficulties and/or the uncertainty of the interpretation. In many instances, an "R" is less ambiguous than other alternatives, especially when there are alternative agents. Do not report "S" unless you have confirmed the result.

For serious situations, take the opportunity to contact the clinical colleague to explain and discuss the results.

- **Omit an uncertain result**

When there are several therapeutic options, or when an ambiguous interpretation cannot be readily resolved in a timely manner, an ATU result is best left either unreported or downgraded (see above).

The Area of Technical Uncertainty is typically listed as a defined MIC value or in disk diffusion a range of zone diameters. ATUs are only listed when obviously needed. The absence of an ATU (MIC and/or zone diameter) means that there is no immediate need for a warning. The ATUs introduced in 2019 (v. 9.0) will be evaluated and ATUs may be added as more information develops.

[Link to the guidance material available on the EUCAST website.](#)

Enterobacterales *

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

MIC determination (broth microdilution according to ISO standard 20776-1 except for mecillinam and fosfomycin where agar dilution is used)

Medium: Mueller-Hinton broth (for cefiderocol, see <https://www.eucast.org/eucastguidancedocuments/>)

Inoculum: 5×10^5 CFU/mL

Incubation: Sealed panels, air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h

Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.

Quality control: *Escherichia coli* ATCC 25922. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor combinations, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)

Medium: Mueller-Hinton agar

Inoculum: McFarland 0.5

Incubation: Air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h

Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.

Quality control: *Escherichia coli* ATCC 25922. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor-combination disks, see EUCAST QC Tables.

* Recent taxonomic studies have narrowed the definition of the family Enterobacteriaceae. Some previous members of this family are now included in other families within the Order *Enterobacterales*. Breakpoints in this table apply to all members of the *Enterobacterales*.

Penicillins ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin	-	-			-	-		1. Aminopenicillin breakpoints in <i>Enterobacterales</i> are based on intravenous administration. For oral administration the breakpoints are relevant for urinary tract infections only. Breakpoints for other infections are under review. 2. For susceptibility testing purposes, the concentration of sulbactam is fixed at 4 mg/L. 3. For susceptibility testing purposes, the concentration of clavulanic acid is fixed at 2 mg/L. 4. For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L. 5. Agar dilution is the reference method for mecillinam MIC determination. A. Ignore growth that may appear as a thin inner zone on some batches of Mueller-Hinton agars. B. Susceptibility inferred from ampicillin. C. Ignore isolated colonies within the inhibition zone.
Ampicillin¹	8	8		10	14 ^A	14 ^A		
Ampicillin-sulbactam¹	8 ²	8 ²		10-10	14 ^A	14 ^A		
Amoxicillin¹	8	8		-	Note ^B	Note ^B		
Amoxicillin-clavulanic acid¹	8 ³	8 ³		20-10	19 ^A	19 ^A	19-20	
Amoxicillin-clavulanic acid (uncomplicated UTI only)	32 ³	32 ³		20-10	16 ^A	16 ^A		
Piperacillin	8	8		30	20	20		
Piperacillin-tazobactam	8 ⁴	8 ⁴	16	30-6	20	20	19	
Ticarcillin	8	16		75	23	20		
Ticarcillin-clavulanic acid	8 ³	16 ³		75-10	23	20		
Temocillin (infections originating from the urinary tract), <i>E. coli</i>, <i>Klebsiella</i> spp. (except <i>K. aerogenes</i>) and <i>P. mirabilis</i>	0.001	16		30	50 ^C	17 ^C		
Phenoxymethylpenicillin	-	-			-	-		
Oxacillin	-	-			-	-		
Cloxacillin	-	-			-	-		
Dicloxacillin	-	-			-	-		
Flucloxacillin	-	-			-	-		
Mecillinam oral (pivmecillinam) (uncomplicated UTI only), <i>E. coli</i>, <i>Citrobacter</i> spp., <i>Klebsiella</i> spp., <i>Raoultella</i> spp., <i>Enterobacter</i> spp. and <i>P. mirabilis</i>	8 ⁵	8 ⁵		10	15 ^C	15 ^C		

Enterobacterales *

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Cephalosporins ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Cefaclor	-	-			-	-		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1. The cephalosporin breakpoints for <i>Enterobacterales</i> will detect all clinically important resistance mechanisms (including ESBL and plasmid mediated AmpC). Some isolates that produce beta-lactamases are susceptible to 3rd or 4th generation cephalosporins with these breakpoints and should be reported as tested, i.e. the presence or absence of an ESBL does not in itself influence the categorisation of susceptibility. ESBL detection and characterisation are recommended for public health and infection control purposes.</p> <p>2/A. Isolates susceptible to cefadroxil and/or cefalexin can be reported "susceptible, increased exposure" (I) to cefazolin.</p> <p>3. Broth microdilution MIC determination must be performed in iron-depleted Mueller-Hinton broth and specific reading instructions must be followed. For testing conditions and reading instructions, see https://www.eucast.org/eucastguidancedocuments/.</p> <p>4. The cefoxitin ECOFF (8 mg/L) has a high sensitivity but poor specificity for identification of AmpC-producing <i>Enterobacterales</i> as this agent is also affected by permeability alterations and some carbapenemases. Classical non-AmpC producers are wild type, whereas plasmid AmpC producers or chromosomal AmpC hyperproducers are non-wild type.</p> <p>5. For susceptibility testing purposes, the concentration of avibactam is fixed at 4 mg/L.</p> <p>6. See table of dosages for dosing for different indications.</p> <p>7. For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L.</p>
Cefadroxil (uncomplicated UTI only)	16	16		30	12	12		
Cefalexin (uncomplicated UTI only)	16	16		30	14	14		
Cefazolin (infections originating from the urinary tract), <i>E. coli</i> , and <i>Klebsiella</i> spp. (except <i>K. aerogenes</i>)	0.001 ²	4 ²		30	50 ^A	20 ^A		
Cefepime	1	4		30	27	24		
Cefiderocol	2 ³	2 ³		30	22	22	18-22	
Cefixime (uncomplicated UTI only)	1	1		5	17	17		
Cefotaxime (indications other than meningitis)	1	2		5	20	17		
Cefotaxime (meningitis)	1	1		5	20	20		
Cefoxitin (screen only) ⁴	Note ⁴	Note ⁴		30	19	19		
Cefpodoxime (uncomplicated UTI only)	1	1		10	21	21		
Ceftaroline	0.5	0.5		5	23	23	22-23	
Ceftazidime	1	4		10	22	19		
Ceftazidime-avibactam	8 ⁵	8 ⁵		10-4	13	13		
Ceftibuten (infections originating from the urinary tract)	1	1		30	23	23		
Ceftobiprole	0.25	0.25		5	23	23		
Ceftolozane-tazobactam ⁶	2 ⁷	2 ⁷		30-10	22	22	19-21	
Ceftriaxone (indications other than meningitis)	1	2		30	25	22		
Ceftriaxone (meningitis)	1	1		30	25	25		
Cefuroxime iv, <i>E. coli</i> , <i>Klebsiella</i> spp. (except <i>K. aerogenes</i>), <i>Raoultella</i> spp. and <i>P. mirabilis</i>	0.001	8		30	50	19		
Cefuroxime oral (uncomplicated UTI only), <i>E. coli</i> , <i>Klebsiella</i> spp. (except <i>K. aerogenes</i>), <i>Raoultella</i> spp. and <i>P. mirabilis</i>	8	8		30	19	19		

Enterobacterales *

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Carbapenems ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doripenem	1	2		10	24	21		1. Some isolates that produce carbapenemase are categorised as susceptible with the current breakpoints and should be reported as tested, i.e. the presence or absence of a carbapenemase does not in itself influence the categorisation of susceptibility. Carbapenemase detection and characterisation are recommended for public health and infection control purposes. For carbapenemase screening a meropenem screening cut-off of >0.125 mg/L (zone diameter <28 mm) is recommended. 2. The intrinsically low activity of imipenem against <i>Morganella morganii</i> , <i>Proteus</i> spp. and <i>Providencia</i> spp. requires the high exposure of imipenem. 3. For susceptibility testing purposes, the concentration of relebactam is fixed at 4 mg/L. 4. For susceptibility testing purposes, the concentration of vaborbactam is fixed at 8 mg/L. A. For isolates in the ATU, if resistant to meropenem report resistant to meropenem-vaborbactam. If not resistant to meropenem, investigate further.
Ertapenem	0.5	0.5		10	25	25		
Imipenem, <i>Enterobacterales</i> except <i>Morganellaceae</i>	2	4		10	22	19		
Imipenem ² , <i>Morganellaceae</i>	0.001	4		10	50	19		
Imipenem-relebactam, <i>Enterobacterales</i> except <i>Morganellaceae</i>	2 ³	2 ³		10-25	22	22		
Meropenem (indications other than meningitis)	2	8		10	22	16		
Meropenem (meningitis)	2	2		10	22	22		
Meropenem-vaborbactam	8 ⁴	8 ⁴		20-10	20	20	15-19 ^A	

Monobactams	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Aztreonam ¹	1	4		30	26	21		1. The aztreonam breakpoints for <i>Enterobacterales</i> will detect clinically important resistance mechanisms (including ESBL). Some isolates that produce beta-lactamases are susceptible to aztreonam with these breakpoints and should be reported as tested, i.e. the presence or absence of an ESBL does not in itself influence the categorisation of susceptibility. ESBL detection and characterisation are recommended for public health and infection control purposes.

Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Ciprofloxacin	0.25	0.5	0.5	5	25	22	22-24	1. There is clinical evidence for ciprofloxacin to indicate a poor response in systemic infections caused by <i>Salmonella</i> spp. with low-level ciprofloxacin resistance (MIC >0.06 mg/L). The available data relate mainly to <i>Salmonella</i> Typhi but there are also case reports of poor response with other <i>Salmonella</i> species. 2/C. The pefloxacin 5 µg breakpoint used to screen for clinical fluoroquinolone resistance in <i>Salmonella</i> spp., can also be used to detect fluoroquinolone resistance mechanisms in other <i>Enterobacterales</i> such as <i>E. coli</i> , <i>K. pneumoniae</i> and <i>Shigella</i> spp. A. Tests with a ciprofloxacin 5 µg disk will not reliably detect low-level resistance in <i>Salmonella</i> spp. To screen for ciprofloxacin resistance in <i>Salmonella</i> spp., use the pefloxacin 5 µg disk. See Note B. B. Susceptibility of <i>Salmonella</i> spp. to ciprofloxacin can be inferred from the pefloxacin disk diffusion screening test. D. A disk diffusion test is not yet developed. Perform an MIC test.
Ciprofloxacin ¹ , <i>Salmonella</i> spp.	0.06	0.06			Note ^A	Note ^A		
Pefloxacin (screen only) ^{1,2} <i>Salmonella</i> spp.	NA	NA		5	24 ^{B,C}	24 ^{B,C}		
Delafloxacin, <i>E. coli</i>	0.125	0.125			Note ^D	Note ^D		
Levofloxacin	0.5	1		5	23	19		
Moxifloxacin	0.25	0.25		5	22	22		
Nalidixic acid (screen only)	NA	NA			NA	NA		
Norfloxacin (uncomplicated UTI only)	0.5	0.5		10	22	22		
Ofloxacin	0.25	0.5		5	24	22		

Enterobacteriales *

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Aminoglycosides ^{1,2}	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Amikacin (systemic infections)	(8) ¹	(8) ¹		30	(18) ^A	(18) ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1/A. For information on how to use breakpoints in brackets, see https://www.eucast.org/eucastguidancedocuments/ . 2. Breakpoints do not apply to <i>Plesiomonas shigelloides</i> since aminoglycosides have low intrinsic activity against this species.
Amikacin (infections originating from the urinary tract)	8	8		30	18	18		
Gentamicin (systemic infections)	(2) ¹	(2) ¹		10	(17) ^A	(17) ^A		
Gentamicin (infections originating from the urinary tract)	2	2		10	17	17		
Netilmicin	IE	IE			IE	IE		
Tobramycin (systemic infections)	(2) ¹	(2) ¹		10	(16) ^A	(16) ^A		
Tobramycin (infections originating from the urinary tract)	2	2		10	16	16		

Glycopeptides and lipoglycopeptides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Dalbavancin	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Oritavancin	-	-			-	-		
Teicoplanin	-	-			-	-		
Telavancin	-	-			-	-		
Vancomycin	-	-			-	-		

Macrolides, lincosamides and streptogramins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Azithromycin ¹	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. Azithromycin has been used in the treatment of enteric infections, primarily with <i>Salmonella</i> Typhi and <i>Shigella</i> spp. For wild-type isolates of both species, the MICs are ≤16 mg/L and the inhibition zone diameters for the azithromycin 15 µg disk ≥12 mm.
Clarithromycin	-	-			-	-		
Erythromycin	-	-			-	-		
Roxithromycin	-	-			-	-		
Telithromycin	-	-			-	-		
Clindamycin	-	-			-	-		
Quinupristin-dalfopristin	-	-			-	-		

Enterobacterales *

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Tetracyclines	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doxycycline	-	-			-	-		1. Tetracycline can be used to predict doxycycline susceptibility for the treatment of <i>Yersinia enterocolitica</i> infections (tetracycline MIC ≤4 mg/L for wild-type isolates). The corresponding zone diameter for the tetracycline 30 µg disk is ≥19 mm. 2. For tigecycline broth microdilution MIC determination, the medium must be prepared fresh on the day of use. 3/A. For other <i>Enterobacterales</i> , the activity of tigecycline varies from insufficient in <i>Proteus</i> spp., <i>Morganella morganii</i> and <i>Providencia</i> spp. to variable in other species. For more information, see https://www.eucast.org/eucastguidancedocuments/ . B. Zone diameter breakpoints validated for <i>E. coli</i> only. For <i>C. koseri</i> , use an MIC method.
Eravacycline, <i>E. coli</i>	0.5	0.5		20	17	17		
Minocycline	-	-			-	-		
Tetracycline¹	-	-			-	-		
Tigecycline, <i>E. coli</i> and <i>C. koseri</i>	0.5 ^{2,3}	0.5 ^{2,3}		15	18 ^{A,B}	18 ^{A,B}		

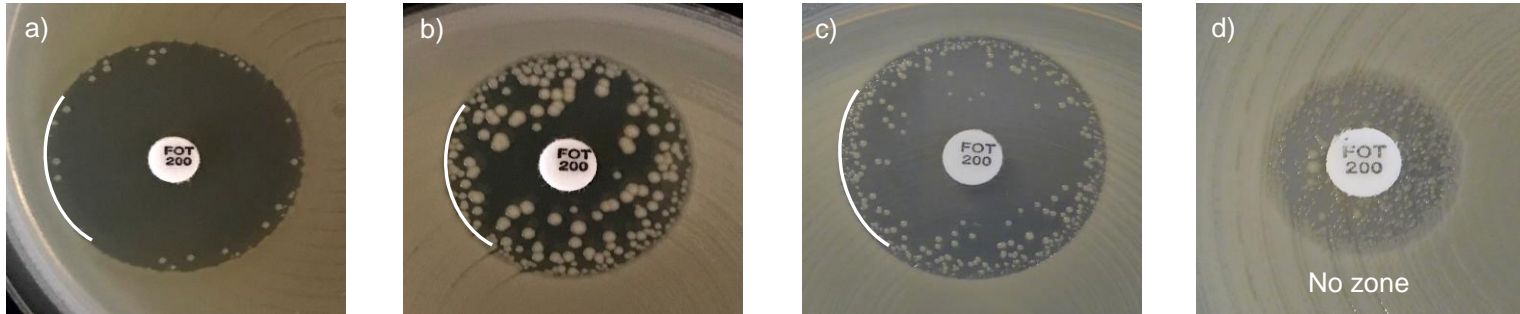
Oxazolidinones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Linezolid	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Tedizolid	-	-			-	-		

Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Chloramphenicol¹	8	8		30	17	17		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. The clinical efficacy of chloramphenicol in meningitis has been questioned and breakpoints are currently under review. For chloramphenicol treatment in meningitis, see table of dosages. 2. Colistin MIC determination should be performed with broth microdilution. Quality control must be performed with both a susceptible QC strain (<i>E. coli</i> ATCC 25922 or <i>P. aeruginosa</i> ATCC 27853) and the colistin resistant <i>E. coli</i> NCTC 13846 (<i>mcr-1</i> positive). 3. For information on how to use breakpoints in brackets, see https://www.eucast.org/eucastguidancedocuments/ . 4. Agar dilution is the reference method for fosfomycin. MICs must be determined in the presence of glucose-6-phosphate (25 mg/L in the medium). Follow the manufacturers' instructions for commercial systems. 5. Trimethoprim:sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration. A. Use an MIC method (broth microdilution only). B. Fosfomycin 200 µg disks must contain 50 µg glucose-6-phosphate. C. Zone diameter breakpoints apply to <i>E. coli</i> only. For other <i>Enterobacterales</i> , use an MIC method. D. Ignore isolated colonies within the inhibition zone (see pictures below).
Colistin²	(2) ³	(2) ³			Note ^A	Note ^A		
Daptomycin	-	-			-	-		
Fosfomycin iv	32 ⁴	32 ⁴		200 ^B	21 ^{C,D}	21 ^{C,D}		
Fosfomycin oral (uncomplicated UTI only), <i>E. coli</i>	8 ⁴	8 ⁴		200 ^B	24 ^D	24 ^D		
Fusidic acid	-	-			-	-		
Lefamulin	-	-			-	-		
Metronidazole	-	-			-	-		
Nitrofurantoin (uncomplicated UTI only), <i>E. coli</i>	64	64		100	11	11		
Nitroxoline (uncomplicated UTI only), <i>E. coli</i>	16	16		30	15	15		
Rifampicin	-	-			-	-		
Spectinomycin	-	-			-	-		
Trimethoprim (uncomplicated UTI only)	4	4		5	15	15		
Trimethoprim-sulfamethoxazole⁵	2	4		1.25-23.75	14	11		

Enterobacterales*

Expert Rules and Intrinsic Resistance Tables

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Examples of inhibition zones for *Escherichia coli* with fosfomycin.

a-c) Ignore all colonies and read the outer zone edge.

d) Record as no inhibition zone.

Pseudomonas spp.

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

MIC determination (broth microdilution according to ISO standard 20776-1 except for fosfomycin where agar dilution is used)

Medium: Mueller-Hinton broth (for cefiderocol, see <https://www.eucast.org/eucastguidancedocuments/>)

Inoculum: 5×10^5 CFU/mL

Incubation: Sealed panels, air, $35 \pm 1^\circ\text{C}$, 18±2h

Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.

Quality control: *Pseudomonas aeruginosa* ATCC 27853. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor combinations, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)

Medium: Mueller-Hinton agar

Inoculum: McFarland 0.5

Incubation: Air, $35 \pm 1^\circ\text{C}$, 18±2h

Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.

Quality control: *Pseudomonas aeruginosa* ATCC 27853. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor-combination disks, see EUCAST QC Tables.

Pseudomonas aeruginosa is the most frequent species of this genus. Other less frequent *Pseudomonas* species recovered in clinical samples are: *P. fluorescens* group, *P. putida* group and *P. stutzeri* group.

Penicillins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin	-	-			-	-		1. For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L. 2. For susceptibility testing purposes, the concentration of clavulanic acid is fixed at 2 mg/L.
Ampicillin	-	-			-	-		
Ampicillin-sulbactam	-	-			-	-		
Amoxicillin	-	-			-	-		
Amoxicillin-clavulanic acid	-	-			-	-		
Piperacillin	0.001	16		30	50	18	18-19	
Piperacillin-tazobactam	0.001 ¹	16 ¹		30-6	50	18	18-19	
Ticarcillin	0.001	16		75	50	18		
Ticarcillin-clavulanic acid	0.001 ²	16 ²		75-10	50	18		
Temocillin	-	-			-	-		
Phenoxymethylpenicillin	-	-			-	-		
Oxacillin	-	-			-	-		
Cloxacillin	-	-			-	-		
Dicloxacillin	-	-			-	-		
Flucloxacillin	-	-			-	-		
Mecillinam oral (pivmecillinam) (uncomplicated UTI only)	-	-			-	-		

Pseudomonas spp.

Expert Rules and Intrinsic Resistance Tables

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Cephalosporins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Cefaclor	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. Broth microdilution MIC determination must be performed in iron-depleted Mueller-Hinton broth and specific reading instructions must be followed. For testing conditions and reading instructions, see https://www.eucast.org/eucastguidancedocuments/ . 2. For susceptibility testing purposes, the concentration of avibactam is fixed at 4 mg/L. 3. See table of dosages for dosing for different indications. 4. For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L.
Cefadroxil	-	-			-	-		
Cefalexin	-	-			-	-		
Cefazolin	-	-			-	-		
Cefepime	0.001	8		30	50	21		
Cefiderocol, <i>P. aeruginosa</i>	2 ¹	2 ¹		30	22	22	14-22	
Cefixime	-	-			-	-		
Cefotaxime	-	-			-	-		
Cefoxitin	-	-			-	-		
Cefpodoxime	-	-			-	-		
Ceftaroline	-	-			-	-		
Ceftazidime	0.001	8		10	50	17		
Ceftazidime-avibactam, <i>P. aeruginosa</i>	8 ²	8 ²		10-4	17	17	16-17	
Ceftibuten	-	-			-	-		
Ceftobiprole	IE	IE			IE	IE		
Ceftolozane-tazobactam ³ , <i>P. aeruginosa</i>	4 ⁴	4 ⁴		30-10	23	23		
Ceftriaxone	-	-			-	-		
Cefuroxime iv	-	-			-	-		
Cefuroxime oral	-	-			-	-		

Carbapenems	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doripenem	0.001	2		10	50	22		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. For susceptibility testing purposes, the concentration of relebactam is fixed at 4 mg/L. 2. For susceptibility testing purposes, the concentration of vaborbactam is fixed at 8 mg/L.
Ertapenem	-	-			-	-		
Imipenem	0.001	4		10	50	20		
Imipenem-relebactam, <i>P. aeruginosa</i>	2 ¹	2 ¹		10-25	22	22		
Meropenem (indications other than meningitis), <i>P. aeruginosa</i>	2	8		10	20	14		
Meropenem (indications other than meningitis), <i>Pseudomonas</i> other than <i>P. aeruginosa</i>	2	8		10	24	18		
Meropenem (meningitis), <i>P. aeruginosa</i>	2	2		10	20	20		
Meropenem-vaborbactam, <i>P. aeruginosa</i>	8 ²	8 ²		20-10	14	14		

***Pseudomonas* spp.**

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Monobactams	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Aztreonam	0.001	16		30	50	18		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Ciprofloxacin	0.001	0.5		5	50	26		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Delafloxacin	IE	IE			IE	IE		
Levofloxacin	0.001	2		5	50	18		
Moxifloxacin	-	-			-	-		
Nalidixic acid (screen only)	NA	NA			NA	NA		
Norfloxacin (uncomplicated UTI only)	-	-			-	-		
Ofloxacin	-	-			-	-		

Aminoglycosides ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Amikacin (systemic infections)	(16) ¹	(16) ¹		30	(15) ^A	(15) ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1/A. For information on how to use breakpoints in brackets, see https://www.eucast.org/eucastguidancedocuments/ .
Amikacin (infections originating from the urinary tract)	16	16		30	15	15		
Gentamicin (systemic infections)	IE	IE			IE	IE		
Gentamicin (infections originating from the urinary tract)	IE	IE			IE	IE		
Netilmicin	IE	IE			IE	IE		
Tobramycin (systemic infections)	(2) ¹	(2) ¹		10	(18) ^A	(18) ^A		
Tobramycin (infections originating from the urinary tract)	2	2		10	18	18		

Glycopeptides and lipoglycopeptides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Dalbavancin	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Oritavancin	-	-			-	-		
Teicoplanin	-	-			-	-		
Telavancin	-	-			-	-		
Vancomycin	-	-			-	-		

***Pseudomonas* spp.**

Expert Rules and Intrinsic Resistance Tables

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Macrolides, lincosamides and streptogramins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Azithromycin	-	-			-	-		
Clarithromycin	-	-			-	-		
Erythromycin	-	-			-	-		
Roxithromycin	-	-			-	-		
Telithromycin	-	-			-	-		
Clindamycin	-	-			-	-		
Quinupristin-dalfopristin	-	-			-	-		

Tetracyclines	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Doxycycline	-	-			-	-		
Eravacycline	-	-			-	-		
Minocycline	-	-			-	-		
Tetracycline	-	-			-	-		
Tigecycline	-	-			-	-		

Oxazolidinones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Linezolid	-	-			-	-		
Tedizolid	-	-			-	-		

***Pseudomonas* spp.**

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Chloramphenicol	-	-			-	-		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1. Colistin MIC determination should be performed with broth microdilution. Quality control must be performed with both a susceptible QC strain (<i>E. coli</i> ATCC 25922 or <i>P. aeruginosa</i> ATCC 27853) and the colistin resistant <i>E. coli</i> NCTC 13846 (<i>mcr-1</i> positive).</p> <p>2. For information on how to use breakpoints in brackets, see https://www.eucast.org/eucastguidancedocuments/.</p> <p>3. Agar dilution is the reference method for fosfomycin. MICs must be determined in the presence of glucose-6-phosphate (25 mg/L in the medium). Follow the manufacturers' instructions for commercial systems. Infections caused by wild-type isolates (ECOFF: MIC 128 mg/L; corresponding zone diameter 12 mm using the disk potency and reading instructions for <i>E. coli</i>) have been treated with fosfomycin in combination with other agents.</p> <p>A. Use an MIC method (broth microdilution only).</p>
Colistin ¹	(4) ²	(4) ²			Note ^A	Note ^A		
Daptomycin	-	-			-	-		
Fosfomycin iv ³	-	-			-	-		
Fosfomycin oral ³	-	-			-	-		
Fusidic acid	-	-			-	-		
Lefamulin	-	-			-	-		
Metronidazole	-	-			-	-		
Nitrofurantoin (uncomplicated UTI only)	-	-			-	-		
Nitroxoline (uncomplicated UTI only)	-	-			-	-		
Rifampicin	-	-			-	-		
Spectinomycin	-	-			-	-		
Trimethoprim (uncomplicated UTI only)	-	-			-	-		
Trimethoprim-sulfamethoxazole	-	-			-	-		

Stenotrophomonas maltophilia
Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Trimethoprim-sulfamethoxazole is the only agent for which EUCAST breakpoints are currently available. For further information, see [EUCAST Guidance Document for *S. maltophilia*](#).

An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

MIC determination (broth microdilution according to ISO standard 20776-1)
Medium: Mueller-Hinton broth (for cefiderocol, see <https://www.eucast.org/eucastguidancedocuments/>)
Inoculum: 5×10^5 CFU/mL
Incubation: Sealed panels, air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h
Reading: For trimethoprim-sulfamethoxazole, the MIC should be read at the lowest concentration that inhibits approximately 80% of growth as compared with the growth control well. See "EUCAST Reading Guide for broth microdilution" for further information.
Quality control: *Escherichia coli* ATCC 25922

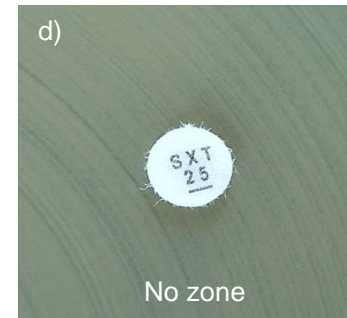
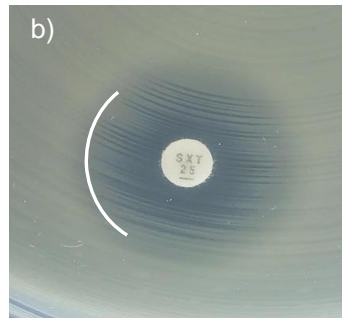
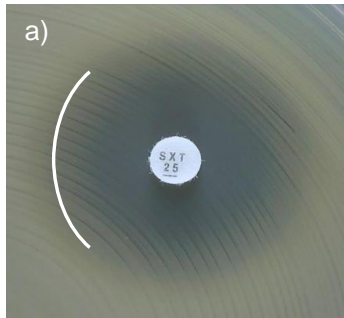
Disk diffusion (EUCAST standardised disk diffusion method)
Medium: Mueller-Hinton agar
Inoculum: McFarland 0.5
Incubation: Air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h
Reading: Read zone edges from the back of the plate against a dark background illuminated with reflected light (see below for specific instructions). See "EUCAST Reading Guide for disk diffusion" for further information.
Quality control: *Escherichia coli* ATCC 25922

Cephalosporins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Cefiderocol	IE ¹	IE ¹			Note ^A	Note ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. Broth microdilution MIC determination must be performed in iron-depleted Mueller-Hinton broth and specific reading instructions must be followed. For testing conditions and reading instructions, see https://www.eucast.org/eucastguidancedocuments/ . A. Zone diameters of ≥ 20 mm for the cefiderocol 30 µg disk correspond to MIC values below the PK-PD breakpoint of $S \leq 2$ mg/L.

Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Trimethoprim-sulfamethoxazole¹	0.001	4		1.25-23.75	50 ^A	16 ^{A,B}		1. Trimethoprim:sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration. A. There may be growth within the inhibition zone. The density of growth may vary from a fine haze to substantial growth (see pictures below). If any zone edge can be seen, ignore growth within the inhibition zone and read the zone diameter. B. Trimethoprim-sulfamethoxazole resistance in <i>S. maltophilia</i> is rare and should be confirmed with an MIC test.

Stenotrophomonas maltophilia
Expert Rules and Intrinsic Resistance Tables

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Examples of inhibition zones for *Stenotrophomonas maltophilia* with trimethoprim-sulfamethoxazole.
a-c) An outer zone can be seen. Read the outer zone edge and interpret according to the breakpoints.
d) Growth up to the disk **and** no sign of inhibition zone. Report resistant.

Acinetobacter spp.

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

MIC determination (broth microdilution according to ISO standard 20776-1)

Medium: Mueller-Hinton broth (for cefiderocol, see <https://www.eucast.org/eucastguidancedocuments/>)

Inoculum: 5×10^5 CFU/mL

Incubation: Sealed panels, air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h

Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.

Quality control: *Pseudomonas aeruginosa* ATCC 27853. For agents not covered by this strain, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)

Medium: Mueller-Hinton agar

Inoculum: McFarland 0.5

Incubation: Air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h

Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.

Quality control: *Pseudomonas aeruginosa* ATCC 27853. For agents not covered by this strain, see EUCAST QC Tables.

This genus includes several species. The most frequent *Acinetobacter* species recovered in clinical samples are those included in the *A. baumannii* group, which includes *A. baumannii*, *A. nosocomialis*, *A. pittii*, *A. dijkschoorniae* and *A. seifertii*. Other species are *A. haemolyticus*, *A. junii*, *A. lwoffii*, *A. ursingii* and *A. variabilis*.

Penicillins ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin	-	-			-	-		1. Susceptibility testing of <i>Acinetobacter</i> spp. to penicillins is unreliable. In most instances, <i>Acinetobacter</i> spp. are resistant to penicillins.
Ampicillin	-	-			-	-		
Ampicillin-sulbactam	IE	IE			IE	IE		
Amoxicillin	-	-			-	-		
Amoxicillin-clavulanic acid	-	-			-	-		
Piperacillin	IE	IE			IE	IE		
Piperacillin-tazobactam	IE	IE			IE	IE		
Ticarcillin	IE	IE			IE	IE		
Ticarcillin-clavulanic acid	IE	IE			IE	IE		
Temocillin	-	-			-	-		
Phenoxymethylpenicillin	-	-			-	-		
Oxacillin	-	-			-	-		
Cloxacillin	-	-			-	-		
Dicloxacillin	-	-			-	-		
Flucloxacillin	-	-			-	-		
Mecillinam oral (pivmecillinam) (uncomplicated UTI only)	-	-			-	-		

Acinetobacter spp.

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Cephalosporins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Cefaclor	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. Broth microdilution MIC determination must be performed in iron-depleted Mueller-Hinton broth and specific reading instructions must be followed. For testing conditions and reading instructions, see https://www.eucast.org/eucastguidancedocuments/ . A. Zone diameters of ≥17 mm for the cefiderocol 30 µg disk correspond to MIC values below the PK-PD breakpoint of S ≤ 2 mg/L.
Cefadroxil	-	-			-	-		
Cefalexin	-	-			-	-		
Cefazolin	-	-			-	-		
Cefepime	-	-			-	-		
Cefiderocol	IE ¹	IE ¹			Note ^A	Note ^A		
Cefixime	-	-			-	-		
Cefotaxime	-	-			-	-		
Cefoxitin	-	-			-	-		
Cefpodoxime	-	-			-	-		
Ceftaroline	-	-			-	-		
Ceftazidime	-	-			-	-		
Ceftazidime-avibactam	-	-			-	-		
Ceftibuten	-	-			-	-		
Ceftobiprole	-	-			-	-		
Ceftolozane-tazobactam	-	-			-	-		
Ceftriaxone	-	-			-	-		
Cefuroxime iv	-	-			-	-		
Cefuroxime oral	-	-			-	-		

Carbapenems	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doripenem	0.001	2		10	50	22		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. For susceptibility testing purposes, the concentration of relebactam is fixed at 4 mg/L. 2/A. The beta-lactamases produced by the organisms either do not modify the parent carbapenem or are not affected by the inhibitor. Therefore the addition of the beta-lactamase inhibitor does not add clinical benefit.
Ertapenem	-	-			-	-		
Imipenem	2	4		10	24	21		
Imipenem-relebactam ²	2 ¹	2 ¹		10-25	24	24		
Meropenem (indications other than meningitis)	2	8		10	21	15		
Meropenem (meningitis)	2	2		10	21	21		
Meropenem-vaborbactam ²	Note ²	Note ²			Note ^A	Note ^A		

Monobactams	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Aztreonam	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

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Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Ciprofloxacin	0.001	1		5	50	21		
Delafloxacin	IE	IE			IE	IE		
Levofloxacin	0.5	1		5	23	20		
Moxifloxacin	-	-			-	-		
Nalidixic acid (screen only)	NA	NA			NA	NA		
Norfloxacin (uncomplicated UTI only)	-	-			-	-		
Ofloxacin	-	-			-	-		

Aminoglycosides ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Amikacin (systemic infections)	(8) ¹	(8) ¹		30	(19) ^A	(19) ^A		1/A. For information on how to use breakpoints in brackets, see https://www.eucast.org/eucastguidancedocuments/ .
Amikacin (infections originating from the urinary tract)	8	8		30	19	19		
Gentamicin (systemic infections)	(4) ¹	(4) ¹		10	(17) ^A	(17) ^A		
Gentamicin (infections originating from the urinary tract)	4	4		10	17	17		
Netilmicin	IE	IE			IE	IE		
Tobramycin (systemic infections)	(4) ¹	(4) ¹		10	(17) ^A	(17) ^A		
Tobramycin (infections originating from the urinary tract)	4	4		10	17	17		

Glycopeptides and lipoglycopeptides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Dalbavancin	-	-			-	-		
Oritavancin	-	-			-	-		
Teicoplanin	-	-			-	-		
Telavancin	-	-			-	-		
Vancomycin	-	-			-	-		

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Macrolides, lincosamides and streptogramins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Azithromycin	-	-			-	-		
Clarithromycin	-	-			-	-		
Erythromycin	-	-			-	-		
Roxithromycin	-	-			-	-		
Telithromycin	-	-			-	-		
Clindamycin	-	-			-	-		
Quinupristin-dalfopristin	-	-			-	-		

Tetracyclines	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Doxycycline	-	-			-	-		
Eravacycline	IE	IE			IE	IE		
Minocycline	IE	IE			IE	IE		
Tetracycline	-	-			-	-		
Tigecycline	IE	IE			IE	IE		

Oxazolidinones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Linezolid	-	-			-	-		
Tedizolid	-	-			-	-		

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Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Chloramphenicol	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. Colistin MIC determination should be performed with broth microdilution. Quality control must be performed with both a susceptible QC strain (<i>E. coli</i> ATCC 25922 or <i>P. aeruginosa</i> ATCC 27853) and the colistin resistant <i>E. coli</i> NCTC 13846 (<i>mcr-1</i> positive). 2. For information on how to use breakpoints in brackets, see https://www.eucast.org/eucastguidancedocuments/ . 3. Trimethoprim:sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration. A. Use an MIC method (broth microdilution only).
Colistin ¹	(2) ²	(2) ²			Note ^A	Note ^A		
Daptomycin	-	-			-	-		
Fosfomycin iv	-	-			-	-		
Fosfomycin oral	-	-			-	-		
Fusidic acid	-	-			-	-		
Lefamulin	-	-			-	-		
Metronidazole	-	-			-	-		
Nitrofurantoin (uncomplicated UTI only)	-	-			-	-		
Nitroxoline (uncomplicated UTI only)	-	-			-	-		
Rifampicin	-	-			-	-		
Spectinomycin	-	-			-	-		
Trimethoprim (uncomplicated UTI only)	-	-			-	-		
Trimethoprim-sulfamethoxazole ³	2	4		1.25-23.75	14	11		

Staphylococcus spp.

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An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

MIC determination (broth microdilution according to ISO standard 20776-1 except for fosfomycin where agar dilution is used)
Medium: Mueller-Hinton broth
Inoculum: 5×10^5 CFU/mL
Incubation: Sealed panels, air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h
Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.
Quality control: *Staphylococcus aureus* ATCC 29213. For agents not covered by this strain, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)
Medium: Mueller-Hinton agar
Inoculum: McFarland 0.5
Incubation: Air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h
Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light (except for benzylpenicillin, see below). See "EUCAST Reading Guide for disk diffusion" for further information.
Quality control: *Staphylococcus aureus* ATCC 29213. For agents not covered by this strain, see EUCAST QC Tables.

Unless otherwise indicated, breakpoints apply to all members of the *Staphylococcus* genus. Where such information exists, specific breakpoints are provided.

- For coagulase-positive species other than *S. aureus* (*S. argenteus*, *S. schweizeri*, *S. intermedius*, *S. pseudintermedius* and *S. coagulans*) there is limited information on the performance of breakpoints for most agents. For *S. argenteus*, breakpoints for *S. aureus* can be used without caveats.
- Coagulase-negative staphylococci include *S. capitis*, *S. cohnii*, *S. epidermidis*, *S. haemolyticus*, *S. hominis*, *S. hyicus*, *S. lugdunensis*, *S. pettenkoferi*, *S. saprophyticus*, *S. schleiferi*, *S. sciuri*, *S. simulans*, *S. warneri* and *S. xylosus*.
- For *S. saccharolyticus*, use methodology and breakpoints for Gram-positive for anaerobic bacteria and consult EUCAST Guidance Document on how to interpret results when there are no breakpoints, <https://www.eucast.org/eucastguidancedocuments/>.

Penicillins ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin, <i>S. aureus</i>	0.125 ¹	0.125 ¹		1 unit	26 ^{A,B}	26 ^{A,B}	<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. Most <i>S. aureus</i> are penicillinase producers and some are methicillin resistant. Either mechanism renders them resistant to benzylpenicillin, phenoxymethylpenicillin, ampicillin, amoxicillin, piperacillin and ticarcillin. Isolates that test susceptible to benzylpenicillin and ceftiofur can be reported susceptible to all penicillins. Isolates that test resistant to benzylpenicillin but susceptible to ceftiofur are susceptible to β-lactam β-lactamase inhibitor combinations, the isoxazolylic penicillins (oxacillin, cloxacillin, dicloxacillin and flucloxacillin) and nafcillin. For agents given orally, care to achieve sufficient exposure at the site of the infection should be exercised. Isolates that test resistant to ceftiofur are resistant to all penicillins.</p> <p>2/C. Most coagulase-negative staphylococci are penicillinase producers and some are methicillin resistant. Either mechanism renders them resistant to benzylpenicillin, phenoxymethylpenicillin, ampicillin, amoxicillin, piperacillin and ticarcillin. No currently available method can reliably detect penicillinase production in <u>all species</u> of staphylococci but methicillin resistance can be detected with ceftiofur as described.</p> <p>3/D. Ampicillin susceptible <i>S. saprophyticus</i> are <i>mecA</i>-negative and susceptible to ampicillin, amoxicillin and piperacillin (without or with a beta-lactamase inhibitor).</p> <p>B. For <i>S. aureus</i>, disk diffusion is more reliable than MIC determination for detection of penicillinase producers, provided the zone diameter is measured AND the zone edge closely inspected (see pictures below). Examine the zone edge with transmitted light (plate held up to light). If the zone diameter is <26 mm, then report resistant. If the zone diameter is ≥26 mm AND the zone edge is sharp (<u>no reduction of growth towards zone edge, like a "cliff"</u>), then report resistant. If not sharp (<u>reduction of growth towards zone edge, like a "beach"</u>), then report susceptible and if uncertain, then report resistant. Chromogenic cephalosporin-based beta-lactamase tests do not reliably detect staphylococcal penicillinase.</p> <p>E. For screening for methicillin resistance in <i>S. pseudintermedius</i>, <i>S. schleiferi</i> and <i>S. coagulans</i>.</p>	
Benzylpenicillin, <i>S. lugdunensis</i>	0.125	0.125		1 unit	26	26		
Benzylpenicillin, other staphylococci	Note ²	Note ²			Note ^C	Note ^C		
Ampicillin, <i>S. saprophyticus</i>	Note ^{2,3}	Note ^{2,3}		2	18 ^{C,D}	18 ^{C,D}		
Ampicillin-sulbactam	Note ^{1,2,3}	Note ^{1,2,3}			Note ^{A,C,D}	Note ^{A,C,D}		
Amoxicillin	Note ^{1,2,3}	Note ^{1,2,3}			Note ^{A,C,D}	Note ^{A,C,D}		
Amoxicillin-clavulanic acid	Note ^{1,2,3}	Note ^{1,2,3}			Note ^{A,C,D}	Note ^{A,C,D}		
Piperacillin	Note ^{1,2,3}	Note ^{1,2,3}			Note ^{A,C,D}	Note ^{A,C,D}		
Piperacillin-tazobactam	Note ^{1,2,3}	Note ^{1,2,3}			Note ^{A,C,D}	Note ^{A,C,D}		
Ticarcillin	Note ^{1,2}	Note ^{1,2}			Note ^{A,C}	Note ^{A,C}		
Ticarcillin-clavulanic acid	Note ^{1,2}	Note ^{1,2}			Note ^{A,C}	Note ^{A,C}		
Temocillin	-	-			-	-		
Phenoxymethylpenicillin, <i>S. aureus</i>	Note ¹	Note ¹			Note ^A	Note ^A		
Phenoxymethylpenicillin, Coagulase-negative staphylococci	- ²	- ²			Note ^C	Note ^C		
Oxacillin (screen only), <i>S. pseudintermedius</i> , <i>S. schleiferi</i> and <i>S. coagulans</i>	NA	NA		1	20 ^E	20 ^E		

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Penicillins ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Oxacillin ⁴ , other staphylococci	Note ^{1,4}	Note ^{1,4}			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>4. <i>S. aureus</i>, <i>S. lugdunensis</i> and <i>S. saprophyticus</i> with oxacillin MIC values >2 mg/L are mostly methicillin resistant due to the presence of the <i>mecA</i> or <i>mecC</i> gene. Occasionally oxacillin MIC values are high in <i>S. aureus</i> in absence of <i>mec</i>-gene mediated resistance. These isolates have been called BORSA (borderline oxacillin resistant <i>S. aureus</i>). EUCAST does not recommend systematic screening for BORSA. For coagulase-negative staphylococci other than <i>S. saprophyticus</i> and <i>S. lugdunensis</i>, the oxacillin MIC in methicillin resistant isolates is >0.25 mg/L.</p>
Cloxacillin	Note ^{1,2}	Note ^{1,2}			Note ^{A,C}	Note ^{A,C}		
Dicloxacillin	Note ^{1,2}	Note ^{1,2}			Note ^{A,C}	Note ^{A,C}		
Flucloxacillin	Note ^{1,2}	Note ^{1,2}			Note ^{A,C}	Note ^{A,C}		
Mecillinam oral (pivmecillinam) (uncomplicated UTI only)	-	-			-	-		

Cephalosporins ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Cefaclor ²	Note ¹	Note ¹			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. Susceptibility of staphylococci to cephalosporins is inferred from the cefoxitin susceptibility except for cefixime, ceftazidime, ceftazidime-avibactam, ceftibuten and ceftolozane-tazobactam, which do not have breakpoints and should not be used for staphylococcal infections. For agents given orally, care to achieve sufficient exposure at the site of the infection should be exercised. If cefotaxime and ceftriaxone are reported for methicillin-susceptible staphylococci, these should be reported "Susceptible, increased exposure" (I). Some methicillin-resistant <i>S. aureus</i> are susceptible to ceftaroline and ceftobiprole, see Notes 5/D and 7/F.</p> <p>2. See table of dosages.</p> <p>3. <i>S. aureus</i> and <i>S. lugdunensis</i> with cefoxitin MIC values >4 mg/L and <i>S. saprophyticus</i> with cefoxitin MIC values >8 mg/L are methicillin resistant, mostly due to the presence of the <i>mecA</i> or <i>mecC</i> gene. Disk diffusion reliably predicts methicillin resistance.</p> <p>4. For staphylococci other than <i>S. aureus</i>, <i>S. lugdunensis</i> and <i>S. saprophyticus</i>, the cefoxitin MIC is a poorer predictor of methicillin resistance than the disk diffusion test.</p> <p>5/C. In <i>S. pseudintermedius</i>, <i>S. schleiferi</i> and <i>S. coagulans</i> the cefoxitin disk is less predictive for the detection of methicillin resistance than in other staphylococci. Use the oxacillin 1 µg disk with zone diameter breakpoints S≥20, R<20 mm.</p> <p>6/D. Methicillin-susceptible isolates can be reported susceptible to ceftaroline without further testing.</p> <p>7/E. Resistant isolates are rare.</p> <p>8/F. Methicillin-susceptible isolates can be reported susceptible to ceftobiprole without further testing.</p> <p>B. If coagulase-negative staphylococci are not identified to species level, use zone diameter breakpoints S≥25, R<25 mm.</p>
Cefadroxil	Note ¹	Note ¹			Note ^A	Note ^A		
Cefalexin	Note ¹	Note ¹			Note ^A	Note ^A		
Cefazolin	Note ¹	Note ¹			Note ^A	Note ^A		
Cefepime	Note ¹	Note ¹			Note ^A	Note ^A		
Cefiderocol	-	-			-	-		
Cefixime	-	-			-	-		
Cefotaxime ²	Note ¹	Note ¹			Note ^A	Note ^A		
Cefoxitin (screen only), <i>S. aureus</i> and coagulase-negative staphylococci except <i>S. epidermidis</i> and <i>S. lugdunensis</i>	Note ^{3,4}	Note ^{3,4}		30	22 ^{A,B}	22 ^{A,B}		
Cefoxitin (screen only), <i>S. epidermidis</i> and <i>S. lugdunensis</i>	Note ⁴	Note ⁴		30	27 ^{A,B}	27 ^{A,B}	27	
Cefoxitin (screen only), <i>S. pseudintermedius</i> , <i>S. schleiferi</i> and <i>S. coagulans</i>	Note ⁵	Note ⁵			Note ^C	Note ^C		
Cefpodoxime	Note ¹	Note ¹			Note ^A	Note ^A		
Ceftaroline (indications other than pneumonia), <i>S. aureus</i>	1 ⁶	2 ^{6,7}	1	5	20 ^D	17 ^{D,E}	19-20	
Ceftaroline (pneumonia), <i>S. aureus</i>	1 ⁶	1 ⁶	1	5	20 ^D	20 ^D	19-20	
Ceftazidime	-	-			-	-		
Ceftazidime-avibactam	-	-			-	-		
Ceftibuten	-	-			-	-		
Ceftobiprole, <i>S. aureus</i>	2 ⁸	2 ⁸	2	5	17 ^F	17 ^F	16-17	
Ceftolozane-tazobactam	-	-			-	-		
Ceftriaxone ²	Note ¹	Note ¹			Note ^A	Note ^A		
Cefuroxime iv	Note ¹	Note ¹			Note ^A	Note ^A		
Cefuroxime oral	Note ¹	Note ¹			Note ^A	Note ^A		

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Carbapenems ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doripenem	Note ¹	Note ¹			Note ^A	Note ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1/A. Susceptibility of staphylococci to carbapenems is inferred from the ceftoxitin susceptibility.
Ertapenem	Note ¹	Note ¹			Note ^A	Note ^A		
Imipenem	Note ¹	Note ¹			Note ^A	Note ^A		
Imipenem-relebactam	Note ¹	Note ¹			Note ^A	Note ^A		
Meropenem	Note ¹	Note ¹			Note ^A	Note ^A		
Meropenem-vaborbactam	Note ¹	Note ¹			Note ^A	Note ^A		

Monobactams	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Aztreonam	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Fluoroquinolones ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Ciprofloxacin, <i>S. aureus</i>	0.001	1		5	50 ^A	21 ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. For breakpoints for other fluoroquinolones (e.g. pefloxacin and enoxacin), refer to breakpoints set by national breakpoint committees. 2/D. Ofloxacin breakpoints for <i>Staphylococcus</i> spp. have been removed since in systemic infections with staphylococci the agent is inferior to other fluoroquinolones. For topical use of ofloxacin, see tables of topical agents. A. The norfloxacin disk diffusion test can be used to screen for fluoroquinolone resistance. See Note C. B. A disk diffusion test is not yet developed. Perform an MIC test. C. Isolates categorised as screen negative can be reported susceptible to moxifloxacin and "susceptible increased exposure" (I) to ciprofloxacin and levofloxacin. Isolates categorised as screen positive should be tested for susceptibility to individual agents <u>or reported resistant</u> .
Ciprofloxacin, Coagulase-negative staphylococci	0.001	1		5	50 ^A	24 ^A		
Delafloxacin (community-acquired pneumonia), <i>S. aureus</i>	0.016	0.016			Note ^B	Note ^B		
Delafloxacin (skin and skin structure infections), <i>S. aureus</i>	0.25	0.25			Note ^B	Note ^B		
Levofloxacin, <i>S. aureus</i>	0.001	1		5	50 ^A	22 ^A		
Levofloxacin, Coagulase-negative staphylococci	0.001	1		5	50 ^A	24 ^A		
Moxifloxacin, <i>S. aureus</i>	0.25	0.25		5	25 ^A	25 ^A		
Moxifloxacin, Coagulase-negative staphylococci	0.25	0.25		5	28 ^A	28 ^A		
Nalidixic acid (screen only)	NA	NA			NA	NA		
Norfloxacin (screen only)	NA	NA		10	17 ^C	17 ^C		
Ofloxacin	Note ²	Note ²			Note ^D	Note ^D		

Staphylococcus spp.

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Aminoglycosides ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Amikacin² , <i>S. aureus</i>	(16) ¹	(16) ¹		30	(15) ^A	(15) ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. For information on how to use breakpoints in brackets, see https://www.eucast.org/eucastguidancedocuments/.</p> <p>2. Resistance to amikacin is most reliably determined by testing with kanamycin (MIC >8 mg/L). The corresponding zone diameter for the kanamycin 30 µg disk is R<18 mm for <i>S. aureus</i> and R<22 mm for coagulase-negative staphylococci.</p>
Amikacin² , Coagulase-negative staphylococci	(16) ¹	(16) ¹		30	(15) ^A	(15) ^A		
Gentamicin , <i>S. aureus</i>	(2) ¹	(2) ¹		10	(18) ^A	(18) ^A		
Gentamicin , Coagulase-negative staphylococci	(2) ¹	(2) ¹		10	(22) ^A	(22) ^A		
Netilmicin	IE	IE			IE	IE		
Tobramycin , <i>S. aureus</i>	(2) ¹	(2) ¹		10	(18) ^A	(18) ^A		
Tobramycin , Coagulase-negative staphylococci	(2) ¹	(2) ¹		10	(20) ^A	(20) ^A		

Glycopeptides and lipoglycopeptides ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Dalbavancin²	0.125 ^{3,4}	0.125 ³			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1. Glycopeptide MICs are method dependent and should be determined by broth microdilution (ISO standard 20776-1). <i>S. aureus</i> with vancomycin MIC values of 2 mg/L are on the border of the wild-type distribution and there may be an impaired clinical response.</p> <p>2. Resistant isolates are rare or not yet reported. The identification and antimicrobial susceptibility test result on any such isolate must be confirmed and the isolate sent to a reference laboratory.</p> <p>3. MICs must be determined in the presence of polysorbate-80 (0.002% in the medium for broth dilution methods; agar dilution methods have not been validated). Follow the manufacturer's instructions for commercial systems.</p> <p>4. <i>S. aureus</i> isolates susceptible to vancomycin can be reported susceptible to dalbavancin and oritavancin.</p> <p>5. MRSA isolates susceptible to vancomycin can be reported susceptible to telavancin.</p> <p>A. Disk diffusion is unreliable and cannot distinguish between wild type isolates and those with non-<i>vanA</i>-mediated glycopeptide resistance.</p>
Oritavancin² , <i>S. aureus</i>	0.125 ^{3,4}	0.125 ³			Note ^A	Note ^A		
Teicoplanin² , <i>S. aureus</i>	2	2			Note ^A	Note ^A		
Teicoplanin , Coagulase-negative staphylococci	4	4			Note ^A	Note ^A		
Telavancin² , MRSA	0.125 ^{3,5}	0.125 ³			Note ^A	Note ^A		
Vancomycin² , <i>S. aureus</i>	2	2			Note ^A	Note ^A		
Vancomycin² , Coagulase-negative staphylococci	4	4			Note ^A	Note ^A		

Staphylococcus spp.

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Macrolides, lincosamides and streptogramins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Azithromycin	2 ¹	2 ¹			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. Erythromycin can be used to screen for macrolide resistance in staphylococci. Isolates categorised as screen negative can be reported susceptible to azithromycin, clarithromycin and roxithromycin. <u>Isolates categorised as screen positive should be tested for susceptibility to individual agents or reported resistant.</u></p> <p>2. Inducible clindamycin resistance can be detected by antagonism of clindamycin activity by a macrolide agent. If not detected, then report as tested according to the clinical breakpoints. If detected, then report as resistant and consider adding this comment to the report: "Clindamycin may still be used for short-term therapy of less serious skin and soft tissue infections as constitutive resistance is unlikely to develop during such therapy".</p> <p>B. Place the erythromycin and clindamycin disks 12-20 mm apart (edge to edge) and look for antagonism (the D phenomenon) to detect inducible clindamycin resistance.</p> <p>C. Isolates resistant by disk diffusion should be confirmed by MIC testing.</p>
Clarithromycin	1 ¹	2 ¹			Note ^A	Note ^A		
Erythromycin	1	2		15	21	18		
Erythromycin (screen only)	1 ¹	1 ¹		15	21 ^A	21 ^A		
Roxithromycin	1 ¹	2 ¹			Note ^A	Note ^A		
Telithromycin	IE	IE			IE	IE		
Clindamycin ²	0.25	0.25		2	22 ^B	22 ^B		
Quinupristin-dalfopristin	1	2		15	21	18 ^C		

Tetracyclines	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doxycycline	1 ¹	2 ¹			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. Tetracycline can be used to screen for resistance in tetracycline agents. Isolates categorised as screen negative can be reported susceptible to doxycycline and minocycline. <u>Isolates categorised as screen positive should be tested for susceptibility to individual agents or reported resistant.</u></p> <p>2. Resistant isolates are rare or not yet reported. The identification and antimicrobial susceptibility test result on any such isolate must be confirmed and the isolate sent to a reference laboratory.</p> <p>3. For tigecycline broth microdilution MIC determination, the medium must be prepared fresh on the day of use.</p> <p>B. For MRSA that test susceptible with disk diffusion, the results should be confirmed with an MIC test.</p>
Eravacycline, <i>S. aureus</i>	0.25	0.25		20	20 ^B	20 ^B		
Minocycline	0.5 ¹	0.5 ¹		30	23 ^A	23 ^A		
Tetracycline	1	2		30	22	19		
Tetracycline (screen only)	1 ¹	1 ¹		30	22 ^A	22 ^A		
Tigecycline ²	0.5 ³	0.5 ³		15	19	19		

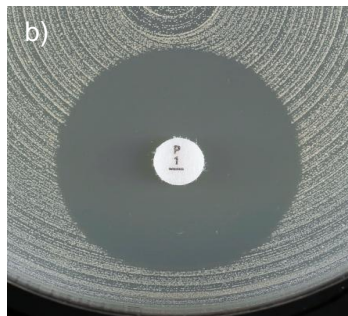
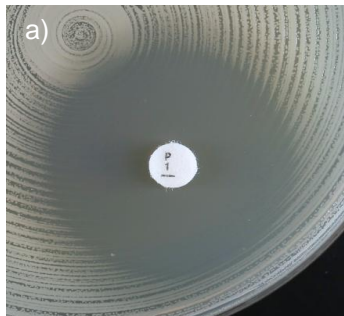
Oxazolidinones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Linezolid	4	4		10	21	21		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. Isolates susceptible to linezolid can be reported susceptible to tedizolid.</p>
Tedizolid	0.5 ¹	0.5		2	20 ^A	20	19	

Staphylococcus spp.

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Chloramphenicol ¹	8	8		30	18	18		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. The clinical efficacy of chloramphenicol in meningitis has been questioned and breakpoints are currently under review. For chloramphenicol treatment in meningitis, see table of dosages. 2. Resistant isolates are rare or not yet reported. The identification and antimicrobial susceptibility test result on any such isolate must be confirmed and the isolate sent to a reference laboratory. 3. Daptomycin MICs must be determined in the presence of Ca ²⁺ (50 mg/L in the medium for broth dilution methods; agar dilution methods have not been validated). Follow the manufacturers' instructions for commercial systems. 4. Agar dilution is the reference method for fosfomycin. MICs must be determined in the presence of glucose-6-phosphate (25 mg/L in the medium). Follow the manufacturers' instructions for commercial systems. 5. Trimethoprim:sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration. A. Use an MIC method.
Colistin	-	-			-	-		
Daptomycin ²	1 ³	1 ³			Note ^A	Note ^A		
Fosfomycin iv	32 ⁴	32 ⁴			Note ^A	Note ^A		
Fosfomycin oral	-	-			-	-		
Fusidic acid	1	1		10	24	24		
Lefamulin, <i>S. aureus</i>	0.25	0.25		5	23	23		
Metronidazole	-	-			-	-		
Nitrofurantoin (uncomplicated UTI only), <i>S. saprophyticus</i>	64	64		100	13	13		
Nitroxoline (uncomplicated UTI only), <i>S. saprophyticus</i>	IE	IE			IE	IE		
Rifampicin	0.06	0.06		5	26	26		
Spectinomycin	-	-			-	-		
Trimethoprim (uncomplicated UTI only)	4	4		5	14	14		
Trimethoprim-sulfamethoxazole ⁵	2	4		1.25-23.75	17	14		



Examples of inhibition zones for *Staphylococcus aureus* with benzylpenicillin.

- a) Fuzzy zone edge (reduction of growth towards zone edge, like a "beach") and zone diameter ≥ 26 mm. Report susceptible.
 b) Sharp zone edge (no reduction of growth towards zone edge, like a "cliff") and zone diameter ≥ 26 mm. Report resistant.

Enterococcus spp.

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

In endocarditis, refer to national or international endocarditis guidelines for breakpoints for *Enterococcus* spp.

An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

MIC determination (broth microdilution according to ISO standard 20776-1)

Medium: Mueller-Hinton broth

Inoculum: 5×10^5 CFU/mL

Incubation: Sealed panels, air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h

Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.

Quality control: *Enterococcus faecalis* ATCC 29212. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor combinations, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)

Medium: Mueller-Hinton agar

Inoculum: McFarland 0.5

Incubation: Air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h (for glycopeptides 24h)

Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light (except for vancomycin, see below). See "EUCAST Reading Guide for disk diffusion" for further information.

Quality control: *Enterococcus faecalis* ATCC 29212. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor combination disks, see EUCAST QC Tables.

This genus includes several species. The most frequent enterococci recovered in clinical samples are *E. faecalis*, *E. faecium*, *E. avium*, *E. casseliflavus*, *E. durans*, *E. gallinarum*, *E. hirae*, *E. mundtii* and *E. raffinosus*. Unless otherwise indicated, breakpoints apply to all members of the *Enterococcus* genus.

Penicillins ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin	-	-			-	-		1. Aminopenicillin breakpoints in enterococci are based on intravenous administration. For oral administration the breakpoints are relevant for urinary tract infections only. 2/A. Susceptibility to ampicillin, amoxicillin and piperacillin (with and without beta-lactamase inhibitor) can be inferred from ampicillin. Ampicillin resistance is uncommon in <i>E. faecalis</i> (confirm with MIC) but common in <i>E. faecium</i> . 3. For susceptibility testing purposes, the concentration of sulbactam is fixed at 4 mg/L. 4. For susceptibility testing purposes, the concentration of clavulanic acid is fixed at 2 mg/L.
Ampicillin ¹	4 ²	8 ²		2	10 ^A	8 ^A		
Ampicillin-sulbactam ¹	4 ^{2,3}	8 ^{2,3}			Note ^A	Note ^A		
Amoxicillin ¹	4 ²	8 ²			Note ^A	Note ^A		
Amoxicillin-clavulanic acid ¹	4 ^{2,4}	8 ^{2,4}			Note ^A	Note ^A		
Piperacillin	Note ²	Note ²			Note ^A	Note ^A		
Piperacillin-tazobactam	Note ²	Note ²			Note ^A	Note ^A		
Ticarcillin	-	-			-	-		
Ticarcillin-clavulanic acid	-	-			-	-		
Temocillin	-	-			-	-		
Phenoxymethylpenicillin	-	-			-	-		
Oxacillin	-	-			-	-		
Cloxacillin	-	-			-	-		
Dicloxacillin	-	-			-	-		
Flucloxacillin	-	-			-	-		
Mecillinam oral (pivmecillinam) (uncomplicated UTI only)	-	-			-	-		

Enterococcus spp.

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Cephalosporins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Cefaclor	-	-			-	-		
Cefadroxil	-	-			-	-		
Cefalexin	-	-			-	-		
Cefazolin	-	-			-	-		
Cefepime	-	-			-	-		
Cefiderocol	-	-			-	-		
Cefixime	-	-			-	-		
Cefotaxime	-	-			-	-		
Cefoxitin	-	-			-	-		
Cefpodoxime	-	-			-	-		
Ceftaroline	-	-			-	-		
Ceftazidime	-	-			-	-		
Ceftazidime-avibactam	-	-			-	-		
Ceftibuten	-	-			-	-		
Ceftobiprole	-	-			-	-		
Ceftolozane-tazobactam	-	-			-	-		
Ceftriaxone	-	-			-	-		
Cefuroxime iv	-	-			-	-		
Cefuroxime oral	-	-			-	-		

Carbapenems	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Doripenem	-	-			-	-		
Ertapenem	-	-			-	-		
Imipenem	0.001	4		10	50	21		
Imipenem-relebactam ¹	Note ¹	Note ¹			Note ^A	Note ^A		
Meropenem	-	-			-	-		
Meropenem-vaborbactam	-	-			-	-		

Monobactams	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Aztreonam	-	-			-	-		

Enterococcus spp.

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Ciprofloxacin (uncomplicated UTI only)	4	4		5	15 ^A	15 ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/B. There are no clinical breakpoints for <i>Enterococcus</i> spp. and moxifloxacin, but moxifloxacin has been used for oral step-down treatment of endocarditis caused by <i>Enterococcus</i> spp. The norfloxacin disk diffusion test or the moxifloxacin MIC ECOFF (1 mg/L) can be used to screen for resistance mechanisms. When screen negative, the isolate should be reported "wild type" or "devoid of fluoroquinolone resistance mechanisms", but not as susceptible to moxifloxacin.</p> <p>A. The norfloxacin disk diffusion test can be used to screen for fluoroquinolone resistance. See Note C.</p> <p>C. Susceptibility to ciprofloxacin and levofloxacin can be inferred from the norfloxacin disk diffusion screening test. For moxifloxacin, see comment 1/B.</p>
Delafloxacin	IE	IE			IE	IE		
Levofloxacin (uncomplicated UTI only)	4	4		5	15 ^A	15 ^A		
Moxifloxacin	Note ¹	Note ¹			Note ^B	Note ^B		
Nalidixic acid (screen only)	NA	NA			NA	NA		
Norfloxacin (screen only)	NA	NA		10	12 ^C	12 ^C		
Ofloxacin	-	-			-	-		

Aminoglycosides ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Amikacin	Note ²	Note ²			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1. Enterococci are intrinsically resistant to aminoglycosides and aminoglycoside monotherapy is ineffective. There is likely to be synergy between aminoglycosides and penicillins or glycopeptides against enterococci without acquired high-level aminoglycoside resistance. All testing is therefore to distinguish between intrinsic and high-level acquired resistance.</p> <p>2/A. Gentamicin can be used to screen for high-level aminoglycoside resistance (HLAR).</p> <p>Negative test: Isolates with gentamicin MIC ≤128 mg/L or a zone diameter ≥8 mm. The isolate is wild type for gentamicin and low-level intrinsic resistant. For other aminoglycosides, this may not be the case. Synergy with penicillins or glycopeptides can be expected if the isolate is susceptible to the penicillin or glycopeptide.</p> <p>Positive test: Isolates with gentamicin MIC >128 mg/L or a zone diameter <8 mm. The isolate is high-level resistant to gentamicin and other aminoglycosides, except streptomycin which must be tested separately if required (see note 3/B). There will be no synergy with penicillins or glycopeptides.</p> <p>3/B. Isolates with high-level gentamicin resistance may not be high-level resistant to streptomycin.</p> <p>Negative test: Isolates with streptomycin MIC ≤512 mg/L or a zone diameter ≥14 mm. The isolate is wild type for streptomycin and low-level intrinsic resistant. Synergy with penicillins or glycopeptides can be expected if the isolate is susceptible to the penicillin or glycopeptide.</p> <p>Positive test: Isolates with streptomycin MIC >512 mg/L or a zone diameter <14 mm. The isolate is high-level resistant to streptomycin. There will be no synergy with penicillins or glycopeptides.</p>
Gentamicin (test for high-level aminoglycoside resistance)	Note ²	Note ²		30	Note ^A	Note ^A		
Netilmicin	Note ²	Note ²			Note ^A	Note ^A		
Streptomycin (test for high-level streptomycin resistance)	Note ³	Note ³		300	Note ^B	Note ^B		
Tobramycin	Note ²	Note ²			Note ^A	Note ^A		

Glycopeptides and lipoglycopeptides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Dalbavancin	IE	IE			IE	IE		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>A. Vancomycin susceptible enterococci exhibit sharp zone edges and do not exhibit colonies in the inhibition zone. Examine zone edges with transmitted light (plate held up to light). If the zone edge is fuzzy, colonies grow within the zone or if you are uncertain, then perform confirmatory testing with PCR or report resistant (see pictures below) even if the zone diameter is ≥ 12 mm. Isolates must not be reported susceptible before 24 h incubation.</p>
Oritavancin	IE	IE			IE	IE		
Teicoplanin	2	2		30	16	16		
Telavancin	IE	IE			IE	IE		
Vancomycin	4	4		5	12 ^A	12 ^A		

Enterococcus spp.

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Macrolides, lincosamides and streptogramins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Azithromycin	-	-			-	-		
Clarithromycin	-	-			-	-		
Erythromycin	-	-			-	-		
Roxithromycin	-	-			-	-		
Telithromycin	-	-			-	-		
Clindamycin	-	-			-	-		
Quinupristin-dalfopristin, <i>E. faecium</i>	1	4		15	22	20		

Tetracyclines	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Doxycycline	-	-			-	-		1. Resistant isolates are rare or not yet reported. The identification and antimicrobial susceptibility test result on any such isolate must be confirmed and the isolate sent to a reference laboratory. 2. For tigecycline broth microdilution MIC determination, the medium must be prepared fresh on the day of use.
Eravacycline, <i>E. faecalis</i>	0.125	0.125		20	22	22		
Eravacycline, <i>E. faecium</i>	0.125	0.125		20	24	24		
Minocycline	-	-			-	-		
Tetracycline	-	-			-	-		
Tigecycline ¹ , <i>E. faecalis</i>	0.25 ²	0.25 ²		15	20	20		
Tigecycline ¹ , <i>E. faecium</i>	0.25 ²	0.25 ²		15	22	22		

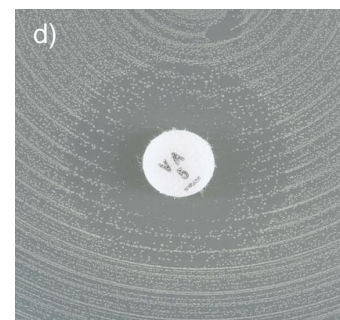
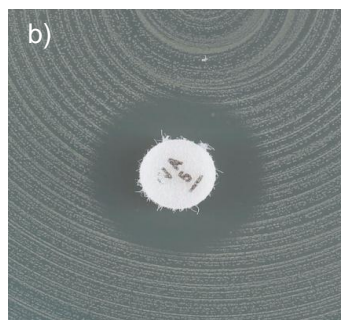
Oxazolidinones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S ≤	R >	ATU		S ≥	R <	ATU	
Linezolid	4	4		10	20	20		
Tedizolid	IE	IE			IE	IE		

Enterococcus spp.

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Chloramphenicol	-	-			-	-		1. For more information, see https://www.eucast.org/eucastguidancedocuments/ . 2/A. Lefamulin has insufficient activity against <i>E. faecalis</i> . For <i>E. faecium</i> , the ECOFF of 0.5 mg/L can be used to distinguish wild type from non-wild type isolates. 3/B. The activity of trimethoprim and trimethoprim-sulfamethoxazole is uncertain against enterococci, and it is not possible to predict clinical outcome. The ECOFF to categorise isolates as wild type or non-wild type for both <i>E. faecalis</i> and <i>E. faecium</i> is 1 mg/L, with a corresponding zone diameter ECOFF of 21 mm for trimethoprim and 23 mm for trimethoprim-sulfamethoxazole. 4. Trimethoprim-sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration.
Colistin	-	-			-	-		
Daptomycin ¹	IE	IE			IE	IE		
Fosfomycin iv	-	-			-	-		
Fosfomycin oral	-	-			-	-		
Fusidic acid	-	-			-	-		
Lefamulin	Note ²	Note ²			Note ^A	Note ^A		
Metronidazole	-	-			-	-		
Nitrofurantoin (uncomplicated UTI only), <i>E. faecalis</i>	64	64		100	15	15		
Nitroxoline (uncomplicated UTI only)	IE	IE			IE	IE		
Rifampicin	-	-			-	-		
Spectinomycin	-	-			-	-		
Trimethoprim (uncomplicated UTI only)	Note ³	Note ³		5	Note ^B	Note ^B		
Trimethoprim-sulfamethoxazole ⁴	Note ³	Note ³		1.25-23.75	Note ^B	Note ^B		



Examples of inhibition zones for *Enterococcus* spp. with vancomycin.

a) Sharp zone edge **and** zone diameter ≥ 12 mm. Report susceptible.

b-d) Fuzzy zone edge or colonies within zone. Perform confirmatory testing with PCR or report resistant even if the zone diameter ≥ 12 mm.

Streptococcus groups A, B, C and G

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

MIC determination (broth microdilution according to ISO standard 20776-1)

Medium: Mueller-Hinton broth + 5% lysed horse blood and 20 mg/L β -NAD (MH-F broth)

Inoculum: 5×10^5 CFU/mL

Incubation: Sealed panels, air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h

Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.

Quality control: *Streptococcus pneumoniae* ATCC 49619. For agents not covered by this strain, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)

Medium: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β -NAD (MH-F)

Inoculum: McFarland 0.5

Incubation: 5% CO_2 , $35 \pm 1^\circ\text{C}$, 18 ± 2 h

Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.

Quality control: *Streptococcus pneumoniae* ATCC 49619. For agents not covered by this strain, see EUCAST QC Tables.

This group of bacteria includes many species, which can be grouped as follows:

Group A: *S. pyogenes*

Group B: *S. agalactiae*

Group C: *S. dysgalactiae* (plus the more rarely isolated *S. equi*)

Group G: *S. dysgalactiae* and *S. canis*

S. dysgalactiae includes the subspecies *equisimilis* and *dysgalactiae*, *S. equi* includes the subspecies *equi* and *zooepidemicus*.

Penicillins ¹	MIC breakpoints (mg/L)			Disk content (μg)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Benzylpenicillin (indications other than meningitis) ²	0.25	0.25		1 unit	18	18		1/A. The susceptibility of streptococcus groups A, B, C and G to penicillins is inferred from the benzylpenicillin susceptibility (indications other than meningitis) with the exception of phenoxymethylpenicillin and isoxazolympenicillins for streptococcus group B. 2. Resistant isolates are rare or not yet reported. The identification and antimicrobial susceptibility test result on any such isolate must be confirmed and the isolate sent to a reference laboratory. 3. The addition of a beta-lactamase inhibitor does not add clinical benefit.
Benzylpenicillin (meningitis) ² , <i>S. agalactiae</i> (group B streptococci)	0.125	0.125		1 unit	19	19		
Ampicillin	Note ¹	Note ¹			Note ^A	Note ^A		
Ampicillin-sulbactam ³	Note ¹	Note ¹			Note ^A	Note ^A		
Amoxicillin	Note ¹	Note ¹			Note ^A	Note ^A		
Amoxicillin-clavulanic acid ³	Note ¹	Note ¹			Note ^A	Note ^A		
Piperacillin	Note ¹	Note ¹			Note ^A	Note ^A		
Piperacillin-tazobactam ³	Note ¹	Note ¹			Note ^A	Note ^A		
Ticarcillin	-	-			-	-		
Ticarcillin-clavulanic acid	-	-			-	-		
Temocillin	-	-			-	-		
Phenoxymethylpenicillin Streptococcus groups A, C and G	Note ¹	Note ¹			Note ^A	Note ^A		
Oxacillin Streptococcus groups A, C and G	Note ¹	Note ¹			Note ^A	Note ^A		
Cloxacillin Streptococcus groups A, C and G	Note ¹	Note ¹			Note ^A	Note ^A		
Dicloxacillin Streptococcus groups A, C and G	Note ¹	Note ¹			Note ^A	Note ^A		
Flucloxacillin Streptococcus groups A, C and G	Note ¹	Note ¹			Note ^A	Note ^A		
Mecillinam oral (pivmecillinam) (uncomplicated UTI only)	-	-			-	-		

Streptococcus groups A, B, C and G

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Cephalosporins ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Cefaclor	Note ¹	Note ¹			Note ^A	Note ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1/A. The susceptibility of streptococcus groups A, B, C and G to cephalosporins is inferred from the benzylpenicillin susceptibility. 2. The addition of a beta-lactamase inhibitor does not add clinical benefit.
Cefadroxil	Note ¹	Note ¹			Note ^A	Note ^A		
Cefalexin	Note ¹	Note ¹			Note ^A	Note ^A		
Cefazolin	Note ¹	Note ¹			Note ^A	Note ^A		
Cefepime	Note ¹	Note ¹			Note ^A	Note ^A		
Cefiderocol	IE	IE			IE	IE		
Cefixime	-	-			-	-		
Cefotaxime	Note ¹	Note ¹			Note ^A	Note ^A		
Cefoxitin		IE				IE		
Cefpodoxime	Note ¹	Note ¹			Note ^A	Note ^A		
Ceftaroline	Note ¹	Note ¹			Note ^A	Note ^A		
Ceftazidime	-	-			-	-		
Ceftazidime-avibactam	-	-			-	-		
Ceftibuten	Note ¹	Note ¹			Note ^A	Note ^A		
Ceftobiprole	IE	IE			IE	IE		
Ceftolozane-tazobactam ²	IE	IE			IE	IE		
Ceftriaxone	Note ¹	Note ¹			Note ^A	Note ^A		
Cefuroxime iv	Note ¹	Note ¹			Note ^A	Note ^A		
Cefuroxime oral	Note ¹	Note ¹			Note ^A	Note ^A		

Carbapenems ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doripenem	Note ¹	Note ¹			Note ^A	Note ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1/A. The susceptibility of streptococcus groups A, B, C and G to carbapenems is inferred from the benzylpenicillin susceptibility. 2/B. The addition of a beta-lactamase inhibitor does not add clinical benefit.
Ertapenem	Note ¹	Note ¹			Note ^A	Note ^A		
Imipenem	Note ¹	Note ¹			Note ^A	Note ^A		
Imipenem-relebactam ²	Note ²	Note ²			Note ^B	Note ^B		
Meropenem	Note ¹	Note ¹			Note ^A	Note ^A		
Meropenem-vaborbactam ²	Note ²	Note ²			Note ^B	Note ^B		

Monobactams	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Aztreonam	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Streptococcus groups A, B, C and G

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Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Ciprofloxacin	-	-			-	-		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>A. A disk diffusion test is not yet developed. Perform an MIC test. B. The norfloxacin disk diffusion test can be used to screen for fluoroquinolone resistance. See Note C. C. Isolates categorised as screen negative can be reported susceptible to moxifloxacin and as "susceptible increased exposure" (I) to levofloxacin. Isolates categorised as screen positive should be tested for susceptibility to individual agents or reported resistant.</p>
Delafloxacin	0.03	0.03			Note ^A	Note ^A		
Levofloxacin	0.001	2		5	50 ^B	17 ^B		
Moxifloxacin	0.5	0.5		5	19 ^B	19 ^B		
Nalidixic acid (screen only)	NA	NA			NA	NA		
Norfloxacin (screen only)	NA	NA		10	12 ^C	12 ^C		
Ofloxacin	-	-			-	-		

Aminoglycosides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Amikacin	-	-			-	-		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p>
Gentamicin	-	-			-	-		
Netilmicin	-	-			-	-		
Tobramycin	-	-			-	-		

Glycopeptides and lipoglycopeptides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Dalbavancin ¹	0.125 ^{2,3}	0.125 ²			Note ^A	Note ^A	<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1. Resistant isolates are rare or not yet reported. The identification and antimicrobial susceptibility test result on any such isolate must be confirmed and the isolate sent to a reference laboratory. 2. MICs must be determined in the presence of polysorbate-80 (0.002% in the medium for broth dilution methods; agar dilution methods have not been validated). Follow the manufacturer's instructions for commercial systems. 3. Isolates susceptible to vancomycin can be reported susceptible to dalbavancin and oritavancin.</p> <p>A. Disk diffusion criteria have not been defined and an MIC method should be used. B. Non-wild type isolates were not available when developing the disk diffusion method.</p>	
Oritavancin ¹	0.25 ^{2,3}	0.25 ²			Note ^A	Note ^A		
Teicoplanin ¹	2	2		30	15 ^B	15 ^B		
Telavancin	IE	IE			IE	IE		
Vancomycin ¹	2	2		5	13 ^B	13 ^B		

Streptococcus groups A, B, C and G

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Macrolides, lincosamides and streptogramins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Azithromycin	0.25 ¹	0.5 ¹			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. Erythromycin can be used to determine susceptibility to azithromycin, clarithromycin and roxithromycin.</p> <p>2. Inducible clindamycin resistance can be detected by antagonism of clindamycin activity by a macrolide agent. If not detected, then report as tested according to the clinical breakpoints. If detected, then report as resistant and consider adding this comment to the report: "Clindamycin may still be used for short-term therapy of less serious skin and soft tissue infections as constitutive resistance is unlikely to develop during such therapy". The clinical importance of inducible clindamycin resistance in combination treatment of severe <i>S. pyogenes</i> infections is not known.</p> <p>B. Place the erythromycin and clindamycin disks 12-16 mm apart (edge to edge) and look for antagonism (the D phenomenon) to detect inducible clindamycin resistance.</p>
Clarithromycin	0.25 ¹	0.5 ¹			Note ^A	Note ^A		
Erythromycin	0.25 ¹	0.5 ¹		15	21 ^A	18 ^A		
Roxithromycin	0.5 ¹	1 ¹			Note ^A	Note ^A		
Telithromycin	0.25	0.5		15	20	17		
Clindamycin ²	0.5	0.5		2	17 ^B	17 ^B		
Quinupristin-dalfopristin	-	-			-	-		

Tetracyclines	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doxycycline	1 ¹	2 ¹			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. Tetracycline can be used to screen for resistance in tetracycline agents. Isolates categorised as screen negative can be reported susceptible to doxycycline and minocycline. <u>Isolates categorised as screen positive should be tested for susceptibility to individual agents or reported resistant.</u></p> <p>2. Resistant isolates are rare or not yet reported. The identification and antimicrobial susceptibility test result on any such isolate must be confirmed and the isolate sent to a reference laboratory.</p> <p>3. For tigecycline broth microdilution MIC determination, the medium must be prepared fresh on the day of use.</p>
Eravacycline	IE	IE			IE	IE		
Minocycline	0.5 ¹	0.5 ¹		30	23 ^A	23 ^A		
Tetracycline	1	2		30	23	20		
Tetracycline (screen only)	1 ¹	1 ¹		30	23 ^A	23 ^A		
Tigecycline ²	0.125 ³	0.125 ³		15	19	19		

Oxazolidinones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Linezolid ¹	2	2		10	19	19		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1. Resistant isolates are rare or not yet reported. The identification and antimicrobial susceptibility test result on any such isolate must be confirmed and the isolate sent to a reference laboratory.</p> <p>2/A. Isolates susceptible to linezolid can be reported susceptible to tedizolid.</p>
Tedizolid ¹	0.5 ²	0.5		2	18 ^A	18 ^A		

Streptococcus groups A, B, C and G

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Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Chloramphenicol ¹	8	8		30	19	19		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1. The clinical efficacy of chloramphenicol in meningitis has been questioned and breakpoints are currently under review. For chloramphenicol treatment in meningitis, see table of dosages.</p> <p>2. Resistant isolates are rare or not yet reported. The identification and antimicrobial susceptibility test result on any such isolate must be confirmed and the isolate sent to a reference laboratory.</p> <p>3. Daptomycin MICs must be determined in the presence of Ca²⁺ (50 mg/L in the medium for broth dilution methods; agar dilution methods have not been validated). Follow the manufacturer's instructions for commercial systems.</p> <p>4. Trimethoprim:sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration.</p> <p>A. Use an MIC method.</p>
Colistin	-	-			-	-		
Daptomycin ²	1 ³	1 ³			Note ^A	Note ^A		
Fosfomicin iv	-	-			-	-		
Fosfomicin oral	-	-			-	-		
Fusidic acid	IE	IE			IE	IE		
Lefamulin	IE	IE			IE	IE		
Metronidazole	-	-			-	-		
Nitrofurantoin (uncomplicated UTI only), <i>S. agalactiae</i> (group B streptococci)	64	64		100	15	15		
Nitroxoline (uncomplicated UTI only)	-	-			-	-		
Rifampicin	0.06	0.06		5	21	21		
Spectinomycin	-	-			-	-		
Trimethoprim (uncomplicated UTI only), <i>S. agalactiae</i> (group B streptococci)	2	2		5	IP	IP		
Trimethoprim-sulfamethoxazole ⁴	1	2		1.25-23.75	18	15		

Streptococcus pneumoniae
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An MIC breakpoint of S ≤ 0.001 mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of "S ≥ 50 mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

MIC determination (broth microdilution according to ISO standard 20776-1)
Medium: Mueller-Hinton broth + 5% lysed horse blood and 20 mg/L β-NAD (MH-F broth)
Inoculum: 5x10⁵ CFU/mL
Incubation: Sealed panels, air, 35±1°C, 18±2h
Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.
Quality control: *Streptococcus pneumoniae* ATCC 49619. For agents not covered by this strain, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)
Medium: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β-NAD (MH-F)
Inoculum: McFarland 0.5 from blood agar or McFarland 1.0 from chocolate agar
Incubation: 5% CO₂, 35±1°C, 18±2h
Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.
Quality control: *Streptococcus pneumoniae* ATCC 49619. For agents not covered by this strain, see EUCAST QC Tables.

Penicillins ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin (indications other than meningitis) ²	0.06	2			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. The oxacillin 1 µg disk diffusion screening test or a benzylpenicillin MIC test shall be used to exclude beta-lactam resistance mechanisms. When the screen is negative (oxacillin inhibition zone ≥20 mm, or benzylpenicillin MIC ≤0.06 mg/L) all beta-lactam agents for which clinical breakpoints are available, including those with "Note" can be reported susceptible without further testing, except for cefaclor, which if reported, should be reported as "susceptible, increased exposure" (I). When the screen is positive (oxacillin zone <20 mm, or benzylpenicillin MIC >0.06 mg/L), see flow chart below.</p> <p>2. For breakpoints and dosing in pneumonia, see table of dosages.</p> <p>3. The addition of a beta-lactamase inhibitor does not add clinical benefit.</p> <p>4/C. Susceptibility inferred from ampicillin (indications other than meningitis).</p> <p>5. For susceptibility testing purposes, the concentration of clavulanic acid is fixed at 2 mg/L.</p> <p>B. For isolates with an oxacillin 1 µg zone <9 mm, determine the MIC. For isolates with an oxacillin zone ≥9 mm, report susceptible without further testing.</p> <p>D. Perform an MIC or infer susceptibility from the ampicillin 2 µg disk diffusion test with ampicillin breakpoints S≥22, R<19 mm.</p> <p>D. For interpretation of the oxacillin disk screen, see flow chart below.</p>
Benzylpenicillin (meningitis)	0.06	0.06			Note ^A	Note ^A		
Ampicillin (indications other than meningitis)	0.5	1		2	22	19		
Ampicillin (meningitis)	0.5	0.5			Note ^{A,B}	Note ^{A,B}		
Ampicillin-sulbactam ³	Note ^{1,4}	Note ^{1,4}			Note ^{A,C}	Note ^{A,C}		
Amoxicillin iv (indications other than meningitis)	Note ^{1,4}	Note ^{1,4}			Note ^{A,C}	Note ^{A,C}		
Amoxicillin iv (meningitis)	0.5	0.5			Note ^{A,B}	Note ^{A,B}		
Amoxicillin oral	0.5	1			Note ^{A,C}	Note ^{A,C}		
Amoxicillin-clavulanic acid iv ³	Note ^{1,4}	Note ^{1,4}			Note ^{A,C}	Note ^{A,C}		
Amoxicillin-clavulanic acid oral ³	0.5 ⁵	1 ⁵			Note ^{A,C}	Note ^{A,C}		
Piperacillin	Note ^{1,4}	Note ^{1,4}			Note ^{A,C}	Note ^{A,C}		
Piperacillin-tazobactam ³	Note ^{1,4}	Note ^{1,4}			Note ^{A,C}	Note ^{A,C}		
Ticarcillin	-	-			-	-		
Ticarcillin-clavulanic acid	-	-			-	-		
Temocillin	-	-			-	-		
Phenoxymethylpenicillin	Note ¹	Note ¹			Note ^A	Note ^A		
Oxacillin (screen only) ¹	NA	NA		1	20 ^D	Note ^D		
Cloxacillin	-	-			-	-		
Dicloxacillin	-	-			-	-		
Flucloxacillin	-	-			-	-		
Mecillinam oral (pivmecillinam) (uncomplicated UTI only)	-	-			-	-		

Streptococcus pneumoniae
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Cephalosporins ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Cefaclor	0.001	0.5		30	50	28		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. The oxacillin 1 µg disk diffusion screening test or a benzylpenicillin MIC test shall be used to exclude beta-lactam resistance mechanisms. When the screen is negative (oxacillin inhibition zone ≥20 mm, or benzylpenicillin MIC ≤0.06 mg/L) all beta-lactam agents for which clinical breakpoints are available, including those with "Note" can be reported susceptible without further testing, except for cefaclor, which if reported, should be reported as "susceptible, increased exposure" (I). When the screen is positive (oxacillin zone <20 mm, or benzylpenicillin MIC >0.06 mg/L), see flow chart below.</p> <p>B. For isolates with an oxacillin 1 µg zone <9 mm, determine the MIC. For isolates with an oxacillin zone ≥9 mm, report susceptible without further testing.</p>
Cefadroxil	-	-			-	-		
Cefalexin	-	-			-	-		
Cefazolin	-	-			-	-		
Cefepime	1	2			Note ^A	Note ^A		
Cefiderocol	IE	IE			IE	IE		
Cefixime	-	-			-	-		
Cefotaxime (indications other than meningitis)	0.5	2			Note ^A	Note ^A		
Cefotaxime (meningitis)	0.5	0.5			Note ^{A,B}	Note ^{A,B}		
Cefoxitin	IE	IE			IE	IE		
Cefpodoxime	0.25	0.5			Note ^A	Note ^A		
Ceftaroline	0.25	0.25			Note ^A	Note ^A		
Ceftazidime	-	-			-	-		
Ceftazidime-avibactam	-	-			-	-		
Ceftibuten	-	-			-	-		
Ceftobiprole	0.5	0.5			Note ^A	Note ^A		
Ceftolozane-tazobactam	-	-			-	-		
Ceftriaxone (indications other than meningitis)	0.5	2			Note ^A	Note ^A		
Ceftriaxone (meningitis)	0.5	0.5			Note ^{A,B}	Note ^{A,B}		
Cefuroxime iv	0.5	1			Note ^A	Note ^A		
Cefuroxime oral	0.25	0.5			Note ^A	Note ^A		

Carbapenems ^{1,2}	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doripenem	1	1			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. The oxacillin 1 µg disk diffusion screening test or a benzylpenicillin MIC test shall be used to exclude beta-lactam resistance mechanisms. When the screen is negative (oxacillin inhibition zone ≥20 mm, or benzylpenicillin MIC ≤0.06 mg/L) all beta-lactam agents for which clinical breakpoints are available, including those with "Note" can be reported susceptible without further testing, except for cefaclor, which if reported, should be reported as "susceptible, increased exposure" (I). When the screen is positive (oxacillin zone <20 mm, or benzylpenicillin MIC >0.06 mg/L), see flow chart below.</p> <p>2. Meropenem is the only carbapenem used for meningitis.</p> <p>3/B. The addition of a beta-lactamase inhibitor does not add clinical benefit.</p> <p>C. For isolates with an oxacillin 1 µg zone <9 mm, determine the MIC. For isolates with an oxacillin zone ≥9 mm, report susceptible without further testing.</p>
Ertapenem	0.5	0.5			Note ^A	Note ^A		
Imipenem	2	2			Note ^A	Note ^A		
Imipenem-relebactam ³	Note ³	Note ³			Note ^B	Note ^B		
Meropenem (indications other than meningitis)	2	2			Note ^A	Note ^A		
Meropenem (meningitis)	0.25	0.25			Note ^{A,C}	Note ^{A,C}		
Meropenem-vaborbactam ³	Note ³	Note ³			Note ^B	Note ^B		

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Monobactams	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Aztreonam	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Ciprofloxacin	-	-			-	-		A. The norfloxacin disk diffusion test can be used to screen for fluoroquinolone resistance. See Note B. B. Isolates categorised as screen negative can be reported susceptible to moxifloxacin and as "susceptible increased exposure" (I) to levofloxacin. Isolates categorised as screen positive should be tested for susceptibility to individual agents <u>or reported resistant</u> .
Delafloxacin	IE	IE			IE	IE		
Levofloxacin	0.001	2		5	50 ^A	16 ^A		
Moxifloxacin	0.5	0.5		5	22 ^A	22 ^A		
Nalidixic acid (screen only)	NA	NA			NA	NA		
Norfloxacin (screen only)	NA	NA		10	10 ^B	10 ^B		
Ofloxacin	-	-			-	-		

Aminoglycosides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Amikacin	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Gentamicin	-	-			-	-		
Netilmicin	-	-			-	-		
Tobramycin	-	-			-	-		

Glycopeptides and lipoglycopeptides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Dalbavancin	IE	IE			IE	IE		1. Resistant isolates are rare or not yet reported. The identification and antimicrobial susceptibility test result on any such isolate must be confirmed and the isolate sent to a reference laboratory.
Oritavancin	IE	IE			IE	IE		
Teicoplanin ¹	2	2		30	17 ^A	17 ^A		A. Non-wild type isolates were not available when developing the disk diffusion method.
Telavancin	IE	IE			IE	IE		
Vancomycin ¹	2	2		5	16 ^A	16 ^A		

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Macrolides, lincosamides and streptogramins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Azithromycin	0.25 ¹	0.5 ¹			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. Erythromycin can be used to determine susceptibility to azithromycin, clarithromycin and roxithromycin.</p> <p>2. Inducible clindamycin resistance can be detected by antagonism of clindamycin activity by a macrolide agent. If not detected, then report as tested according to the clinical breakpoints. If detected, then report as resistant.</p> <p>B. Place the erythromycin and clindamycin disks 12-16 mm apart (edge to edge) and look for antagonism (the D phenomenon) to detect inducible clindamycin resistance.</p>
Clarithromycin	0.25 ¹	0.5 ¹			Note ^A	Note ^A		
Erythromycin	0.25 ¹	0.5 ¹		15	22 ^A	19 ^A		
Roxithromycin	0.5 ¹	1 ¹			Note ^A	Note ^A		
Telithromycin	0.25	0.5		15	23	20		
Clindamycin ²	0.5	0.5		2	19 ^B	19 ^B		
Quinupristin-dalfopristin	-	-			-	-		

Tetracyclines	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doxycycline	1 ¹	2 ¹			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. Tetracycline can be used to screen for resistance in tetracycline agents. Isolates categorised as screen negative can be reported susceptible to doxycycline and minocycline. <u>Isolates categorised as screen positive should be tested for susceptibility to individual agents or reported resistant.</u></p>
Eravacycline	IE	IE			IE	IE		
Minocycline	0.5 ¹	0.5 ¹		30	24 ^A	24 ^A		
Tetracycline	1	2		30	25	22		
Tetracycline (screen only)	1 ¹	1 ¹		30	25 ^A	25 ^A		
Tigecycline	IE	IE			IE	IE		

Oxazolidinones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Linezolid	2	2		10	22	22		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p>
Tedizolid	IE	IE			IE	IE		

Streptococcus pneumoniae
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Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Chloramphenicol ¹	8	8		30	21	21		1. The clinical efficacy of chloramphenicol in meningitis has been questioned and breakpoints are currently under review. For chloramphenicol treatment in meningitis, see table of dosages. 2. Trimethoprim:sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration.
Colistin	-	-			-	-		
Daptomycin	IE	IE			IE	IE		
Fosfomycin iv	IE	IE			IE	IE		
Fosfomycin oral	-	-			-	-		
Fusidic acid	-	-			-	-		
Lefamulin	0.5	0.5		5	12	12		
Metronidazole	-	-			-	-		
Nitrofurantoin (uncomplicated UTI only)	-	-			-	-		
Nitroxoline (uncomplicated UTI only)	-	-			-	-		
Rifampicin	0.125	0.125		5	22	22		
Spectinomycin	-	-			-	-		
Trimethoprim (uncomplicated UTI only)	-	-			-	-		
Trimethoprim-sulfamethoxazole ²	1	2		1.25-23.75	13	10		

***Streptococcus pneumoniae*: Flow chart based on the oxacillin screen test for beta-lactam resistance mechanisms to reduce the number of specific tests for beta-lactam agents**

See the EUCAST warning on the use of benzylpenicillin gradient tests at <http://www.eucast.org/warnings/>.

**Oxacillin 1 µg zone diameter ≥20 mm
(or benzylpenicillin MIC ≤0.06 mg/L)**

Mechanism: excludes all beta-lactam resistance mechanisms

Report susceptible (**S**) to beta-lactam agents for which clinical breakpoints are available, including those with "Note", and those with meningitis breakpoints. **Exception:** Cefaclor is reported "susceptible, increased exposure" (**I**).

No further testing required.

**Oxacillin 1 µg zone diameter <20 mm
(or benzylpenicillin MIC >0.06 mg/L)**

Mechanism: beta-lactam resistance detected

Report: resistant (**R**) to benzylpenicillin (meningitis) and phenoxymethylpenicillin (all indications).

For benzylpenicillin (indications other than meningitis), perform and interpret MIC according to breakpoints.

For other beta-lactam agents, see below.

Oxacillin 1 µg zone diameter 9-19 mm

Report susceptible (**S**) without further testing to: ampicillin, amoxicillin and piperacillin (without and with beta-lactamase inhibitor), cefepime, cefotaxime, ceftaroline, ceftobiprole, ceftriaxone, imipenem and meropenem.

For other beta-lactam agents, perform susceptibility testing for the relevant agent and interpret according to breakpoints.

This guidance is also valid for meningitis breakpoints.

Oxacillin 1 µg zone diameter <9 mm

Perform susceptibility testing for the relevant agent and interpret according to breakpoints.

This guidance is also valid for meningitis breakpoints.

Viridans group streptococci

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In endocarditis, refer to national or international endocarditis guidelines for breakpoints for viridans group streptococci.

MIC determination (broth microdilution according to ISO standard 20776-1)

Medium: Mueller-Hinton broth + 5% lysed horse blood and 20 mg/L β-NAD (MH-F broth)

Inoculum: 5x10⁵ CFU/mL

Incubation: Sealed panels, air, 35±1°C, 18±2h

Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.

Quality control: *Streptococcus pneumoniae* ATCC 49619. For agents not covered by this strain, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)

Medium: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β-NAD (MH-F)

Inoculum: McFarland 0.5

Incubation: 5% CO₂, 35±1°C, 18±2h

Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.

Quality control: *Streptococcus pneumoniae* ATCC 49619. For agents not covered by this strain, see EUCAST QC Tables.

This group of bacteria includes many species, which can be grouped as follows:

S. anginosus group: *S. anginosus*, *S. constellatus*, *S. intermedius*

S. mitis group: *S. australis*, *S. cristatus*, *S. infantis*, *S. mitis*, *S. oligofermentans*, *S. oralis*, *S. peroris*, *S. pseudopneumoniae*, *S. sinensis*

S. sanguinis group: *S. sanguinis*, *S. parasanguinis*, *S. gordonii*

S. bovis group: *S. equinus*, *S. gallolyticus* (*S. bovis*), *S. infantarius*

S. salivarius group: *S. salivarius*, *S. vestibularis*, *S. thermophilus*

S. mutans group: *S. mutans*, *S. sobrinus*

Penicillins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin	0.25	2		1 unit	18	12		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. Benzylpenicillin (MIC or disk diffusion) can be used to screen for beta-lactam resistance in viridans group streptococci. Isolates categorised as screen negative can be reported susceptible to beta-lactam agents for which clinical breakpoints are listed (including those with "Note"). Isolates categorised as screen positive should be tested for susceptibility to individual agents <u>or reported resistant</u>.</p> <p>2. The addition of a beta-lactamase inhibitor does not add clinical benefit.</p> <p>3/B. For benzylpenicillin screen negative isolates (inhibition zone ≥18 mm or MIC ≤0.25 mg/L), susceptibility can be inferred from benzylpenicillin or ampicillin. For benzylpenicillin screen positive isolates (inhibition zone <18 mm or MIC >0.25 mg/L), susceptibility is inferred from ampicillin.</p>
Benzylpenicillin (screen only)	0.25 ¹	0.25 ¹		1 unit	18 ^A	18 ^A		
Ampicillin	0.5	2		2	21	15		
Ampicillin-sulbactam²	Note ^{1,3}	Note ^{1,3}			Note ^{A,B}	Note ^{A,B}		
Amoxicillin	0.5	2			Note ^{A,B}	Note ^{A,B}		
Amoxicillin-clavulanic acid²	Note ^{1,3}	Note ^{1,3}			Note ^{A,B}	Note ^{A,B}		
Piperacillin	Note ^{1,3}	Note ^{1,3}			Note ^{A,B}	Note ^{A,B}		
Piperacillin-tazobactam²	Note ^{1,3}	Note ^{1,3}			Note ^{A,B}	Note ^{A,B}		
Ticarcillin	IE	IE			IE	IE		
Ticarcillin-clavulanic acid²	IE	IE			IE	IE		
Temocillin	-	-			-	-		
Phenoxymethylpenicillin	IE	IE			IE	IE		
Oxacillin	-	-			-	-		
Cloxacillin	-	-			-	-		
Dicloxacillin	-	-			-	-		
Flucloxacillin	-	-			-	-		
Mecillinam oral (pivmecillinam) (uncomplicated UTI only)	-	-			-	-		

Viridans group streptococci
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Cephalosporins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Cefaclor	-	-			-	-		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1. The addition of a beta-lactamase inhibitor does not add clinical benefit.</p> <p>A. Benzylpenicillin (MIC or disk diffusion) can be used to screen for beta-lactam resistance in viridans group streptococci. See Note 1/A on penicillins.</p>
Cefadroxil	-	-			-	-		
Cefalexin	-	-			-	-		
Cefazolin	-	-			-	-		
Cefepime	0.5	0.5		30	25 ^A	25 ^A		
Cefiderocol	IE	IE			IE	IE		
Cefixime	-	-			-	-		
Cefotaxime	0.5	0.5		5	23 ^A	23 ^A		
Cefoxitin	IE	IE			IE	IE		
Cefpodoxime	-	-			-	-		
Ceftaroline	-	-			-	-		
Ceftazidime	-	-			-	-		
Ceftazidime-avibactam	-	-			-	-		
Ceftibuten	-	-			-	-		
Ceftobiprole	-	-			-	-		
Ceftolozane-tazobactam ¹ , <i>S. anginosus</i> group	IE	IE			IE	IE		
Ceftriaxone	0.5	0.5		30	27 ^A	27 ^A		
Cefuroxime iv	0.5	0.5		30	26 ^A	26 ^A		
Cefuroxime oral	-	-			-	-		

Carbapenems	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doripenem	1	1			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1. For susceptibility testing purposes, the concentration of relebactam is fixed at 4 mg/L. 2/B. The addition of a beta-lactamase inhibitor does not add clinical benefit.</p> <p>A. Benzylpenicillin (MIC or disk diffusion) can be used to screen for beta-lactam resistance in viridans group streptococci. See Note 1/A on penicillins.</p>
Ertapenem	0.5	0.5			Note ^A	Note ^A		
Imipenem	2	2			Note ^A	Note ^A		
Imipenem-relebactam ²	2 ¹	2 ¹			Note ^{A,B}	Note ^{A,B}		
Meropenem	2	2			Note ^A	Note ^A		
Meropenem-vaborbactam ²	Note ²	Note ²			Note ^B	Note ^B		

Monobactams	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Aztreonam	-	-			-	-		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p>

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Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Ciprofloxacin	-	-			-	-		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/B. There are no clinical breakpoints for viridans group streptococci and moxifloxacin, but moxifloxacin has been used for oral step-down treatment of endocarditis caused by viridans group streptococci. The moxifloxacin MIC ECOFF (0.5 mg/L) can be used to screen for resistance mechanisms. When screen negative, the isolate should be reported "wild type" or "devoid of fluoroquinolone resistance mechanisms", but not as susceptible to moxifloxacin.</p> <p>A. A disk diffusion test is not yet developed. Perform an MIC test.</p>
Delafloxacin , <i>S. anginosus</i> group	0.03	0.03			Note ^A	Note ^A		
Levofloxacin	IE	IE			IE	IE		
Moxifloxacin	Note ¹	Note ¹			Note ^B	Note ^B		
Nalidixic acid (screen only)	NA	NA			NA	NA		
Norfloxacin (uncomplicated UTI only)	-	-			-	-		
Ofloxacin	-	-			-	-		

Aminoglycosides ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Amikacin	Note ²	Note ²			-	-		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1. Viridans group streptococci are intrinsically resistant to aminoglycosides and aminoglycoside monotherapy is ineffective. There is likely to be synergy between aminoglycosides and penicillins or glycopeptides against streptococci without acquired high-level aminoglycoside resistance. All testing is therefore to distinguish between intrinsic and high-level acquired resistance.</p> <p>2. Gentamicin can be used to screen for high-level aminoglycoside resistance (HLAR). Negative test: Isolates with gentamicin MIC ≤128 mg/L. The isolate is wild type for gentamicin and low-level intrinsic resistant. For other aminoglycosides, this may not be the case. Synergy with penicillins or glycopeptides can be expected if the isolate is susceptible to the penicillin or glycopeptide. Positive test: Isolates with gentamicin MIC >128 mg/L. The isolate is high-level resistant to gentamicin and other aminoglycosides except streptomycin. There will be no synergy with penicillins or glycopeptides.</p>
Gentamicin (test for high-level aminoglycoside resistance)	Note ²	Note ²			-	-		
Netilmicin	Note ²	Note ²			-	-		
Tobramycin	Note ²	Note ²			-	-		

Glycopeptides and lipoglycopeptides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Dalbavancin¹ , <i>S. anginosus</i> group	0.125 ^{2,3}	0.125 ²			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1. Resistant isolates are rare or not yet reported. The identification and antimicrobial susceptibility test result on any such isolate must be confirmed and the isolate sent to a reference laboratory.</p> <p>2. MICs must be determined in the presence of polysorbate-80 (0.002% in the medium for broth dilution methods; agar dilution methods have not been validated). Follow the manufacturer's instructions for commercial systems.</p> <p>3. Isolates susceptible to vancomycin can be reported susceptible to dalbavancin and oritavancin.</p> <p>A. Disk diffusion criteria have not been defined and an MIC method should be used. B. Non-wild type isolates were not available when developing the disk diffusion method.</p>
Oritavancin¹ , <i>S. anginosus</i> group	0.25 ^{2,3}	0.25 ²			Note ^A	Note ^A		
Teicoplanin¹	2	2		30	16 ^B	16 ^B		
Telavancin	IE	IE			IE	IE		
Vancomycin¹	2	2		5	15 ^B	15 ^B		

Viridans group streptococci

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Macrolides, lincosamides and streptogramins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Azithromycin	IE	IE			IE	IE		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. Inducible clindamycin resistance can be detected by antagonism of clindamycin activity by a macrolide agent. If not detected, then report as tested according to the clinical breakpoints. If detected, then report as resistant. A. Place the erythromycin and clindamycin disks 12-16 mm apart (edge to edge) and look for antagonism (the D phenomenon) to detect inducible clindamycin resistance.
Clarithromycin	IE	IE			IE	IE		
Erythromycin	IE	IE		15	IE	IE		
Roxithromycin	IE	IE			IE	IE		
Telithromycin	IE	IE			IE	IE		
Clindamycin ¹	0.5	0.5		2	19 ^A	19 ^A		
Quinupristin-dalfopristin	IE	IE			IE	IE		

Tetracyclines	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doxycycline	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Eravacycline	0.125	0.125		20	17	17		
Minocycline	-	-			-	-		
Tetracycline	-	-			-	-		
Tigecycline	IE	IE			IE	IE		

Oxazolidinones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Linezolid	IE	IE			IE	IE		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Tedizolid, <i>S. anginosus</i> group	0.5	0.5		2	18	18		

Viridans group streptococci

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Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Chloramphenicol	-	-			-	-		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. There are no clinical breakpoints for viridans group streptococci and rifampicin, but rifampicin has been used for oral step-down treatment of endocarditis caused by viridans group streptococci. The rifampicin MIC ECOFF (0.125 mg/L) can be used to screen for resistance mechanisms. When screen negative, the isolate should be reported "wild type" or "devoid rifampicin resistance mechanisms", but not as susceptible to rifampicin.</p>
Colistin	-	-			-	-		
Daptomycin	-	-			-	-		
Fosfomycin iv	-	-			-	-		
Fosfomycin oral	-	-			-	-		
Fusidic acid	-	-			-	-		
Lefamulin	IE	IE			IE	IE		
Metronidazole	-	-			-	-		
Nitrofurantoin (uncomplicated UTI only)	-	-			-	-		
Nitroxoline (uncomplicated UTI only)	-	-			-	-		
Rifampicin	Note ¹	Note ¹			Note ^A	Note ^A		
Spectinomycin	-	-			-	-		
Trimethoprim (uncomplicated UTI only)	-	-			-	-		
Trimethoprim-sulfamethoxazole	-	-			-	-		

Haemophilus influenzae
Expert Rules and Intrinsic Resistance Tables

EUCAST breakpoints have been defined for *H. influenzae* only. Clinical data for other *Haemophilus* species are scarce. MIC distributions for *H. parainfluenzae* are similar to those for *H. influenzae*. In the absence of specific breakpoints, the *H. influenzae* MIC breakpoints can be applied to *H. parainfluenzae*.

An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

MIC determination (broth microdilution according to ISO standard 20776-1)
Medium: Mueller-Hinton broth + 5% lysed horse blood and 20 mg/L β -NAD (MH-F broth)
Inoculum: 5×10^5 CFU/mL
Incubation: Sealed panels, air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h
Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.
Quality control: *Haemophilus influenzae* ATCC 49766. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor combinations, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)
Medium: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β -NAD (MH-F)
Inoculum: McFarland 0.5
Incubation: 5% CO_2 , $35 \pm 1^\circ\text{C}$, 18 ± 2 h
Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.
Quality control: *Haemophilus influenzae* ATCC 49766. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor-combination disks, see EUCAST QC Tables.

Penicillins ¹	MIC breakpoints (mg/L)			Disk content (μg)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Benzylpenicillin	IE	IE			IE	IE		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. The benzylpenicillin 1 unit disk diffusion screening test shall be used to exclude beta-lactam resistance mechanisms. When the screen is negative (inhibition zone ≥ 12 mm) all penicillins for which clinical breakpoints are available, including those with "Note", can be reported susceptible without further testing, except for amoxicillin oral and amoxicillin-clavulanic acid oral, which if reported, should be reported "susceptible, increased exposure" (I). When the screen is positive (inhibition zone <12 mm), see flow chart below.</p> <p>2. Beta-lactamase positive isolates can be reported resistant to ampicillin, amoxicillin and piperacillin without inhibitors. Tests based on a chromogenic cephalosporin can be used to detect the beta-lactamase.</p> <p>3. For susceptibility testing purposes, the concentration of sulbactam is fixed at 4 mg/L.</p> <p>4/D. Susceptibility can be inferred from amoxicillin-clavulanic acid iv.</p> <p>5. For susceptibility testing purposes, the concentration of clavulanic acid is fixed at 2 mg/L.</p> <p>6. For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L.</p> <p>B. Read the outer edge of zones where an otherwise clear inhibition zone contains an area of growth around the disk, see pictures below.</p> <p>C. ATU relevant only if the benzylpenicillin 1 unit disk screen is positive (inhibition zone <12 mm).</p> <p>E. Susceptibility can be inferred from ampicillin.</p> <p>F. Isolates susceptible to ampicillin can be reported "susceptible, increased exposure" (I) to amoxicillin oral. <u>Isolates resistant to ampicillin can be reported resistant to amoxicillin oral.</u></p>
Benzylpenicillin (screen only) ¹	NA	NA		1 unit	12 ^{A,B}	Note ^{A,B}		
Ampicillin (indications other than meningitis) ²	1	1		2	18 ^{A,B}	18 ^{A,B}		
Ampicillin (meningitis) ²	IE	IE			IE	IE		
Ampicillin-sulbactam	1 ^{3,4}	1 ^{3,4}			Note ^{A,D}	Note ^{A,D}		
Amoxicillin iv (indications other than meningitis) ²	2	2			Note ^{A,E}	Note ^{A,E}		
Amoxicillin iv (meningitis) ²	IE	IE			IE	IE		
Amoxicillin oral ²	0.001	2			Note ^{A,F}	Note ^{A,F}		
Amoxicillin-clavulanic acid iv	2 ⁵	2 ⁵		2-1	15 ^{A,B}	15 ^{A,B}		
Amoxicillin-clavulanic acid oral	0.001 ⁵	2 ⁵		2-1	50 ^{A,B}	15 ^{A,B}		
Piperacillin ²	IE	IE			IE	IE		
Piperacillin-tazobactam	0.25 ⁶	0.25 ⁶		30-6	27 ^{A,B}	27 ^{A,B}	24-27 ^{B,C}	
Ticarcillin	IE	IE			IE	IE		
Ticarcillin-clavulanic acid	IE	IE			IE	IE		
Temocillin	IE	IE			IE	IE		
Phenoxyethylpenicillin	IE	IE			IE	IE		
Oxacillin	-	-			-	-		
Cloxacillin	-	-			-	-		
Dicloxacillin	-	-			-	-		
Flucloxacillin	-	-			-	-		
Mecillinam oral (pivmecillinam) (uncomplicated UTI only)	-	-			-	-		

Haemophilus influenzae
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Cephalosporins ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Cefaclor	-	-			-	-		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. The benzylpenicillin 1 unit disk diffusion screening test shall be used to exclude beta-lactam resistance mechanisms. When the screen is negative (inhibition zone ≥12 mm) all cephalosporins for which clinical breakpoints are available, including those with "Note", can be reported susceptible without further testing, except for cefuroxime oral, which if reported, should be reported "susceptible, increased exposure" (I). When the screen is positive (inhibition zone <12 mm), see flow chart below.</p> <p>2. See table of dosages for dosing for different indications.</p> <p>3/C. ATU relevant only if the benzylpenicillin 1 unit disk screen is positive (inhibition zone <12 mm).</p> <p>4. The breakpoints also apply to meningitis.</p> <p>B. Read the outer edge of zones where an otherwise clear inhibition zone contains an area of growth around the disk, see pictures below.</p> <p>D. For benzylpenicillin 1 unit disk screen positive isolates (inhibition zone <12 mm), determine the MIC.</p>
Cefadroxil	-	-			-	-		
Cefalexin	-	-			-	-		
Cefazolin	-	-			-	-		
Cefepime	0.25	0.25		30	28 ^{A,B}	28 ^{A,B}	28-33 ^{B,C}	
Cefiderocol	IE	IE			IE	IE		
Cefixime	0.125	0.125		5	26 ^{A,B}	26 ^{A,B}		
Cefotaxime (indications other than meningitis)	0.125	0.125		5	27 ^{A,B}	27 ^{A,B}	25-27 ^{B,C}	
Cefotaxime (meningitis)	0.125	0.125		5	27 ^{A,B,D}	27 ^{A,B,D}	25-27 ^{B,D}	
Cefoxitin	IE	IE			IE	IE		
Cefpodoxime	0.25	0.25		10	26 ^{A,B}	26 ^{A,B}	26-29 ^{B,C}	
Ceftaroline	0.03	0.03			Note ^A	Note ^A		
Ceftazidime	-	-			-	-		
Ceftazidime-avibactam	-	-			-	-		
Ceftibuten	1	1		30	25 ^{A,B}	25 ^{A,B}		
Ceftobiprole	IE	IE			IE	IE		
Ceftolozane-tazobactam (pneumonia) ²	0.5	0.5		30-10	23 ^{A,B}	23 ^{A,B}	22-23 ^{B,C}	
Ceftriaxone (indications other than meningitis)	0.125	0.125		30	32 ^{A,B}	32 ^{A,B}	31-33 ^{B,C}	
Ceftriaxone (meningitis)	0.125	0.125		30	32 ^{A,B,D}	32 ^{A,B,D}	31-33 ^{B,D}	
Cefuroxime iv	1	2	2 ³	30	27 ^{A,B}	25 ^{A,B}	25-27 ^{B,C}	
Cefuroxime oral	0.001	1		30	50 ^{A,B}	27 ^{A,B}	25-27 ^{B,C}	

Carbapenems ^{1,2}	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doripenem	1	1		10	23 ^{A,B}	23 ^{A,B}		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. The benzylpenicillin 1 unit disk diffusion screening test shall be used to exclude beta-lactam resistance mechanisms. When the screen is negative (inhibition zone ≥12 mm) all carbapenems for which clinical breakpoints are available, including those with "Note", can be reported susceptible without further testing. When the screen is positive (inhibition zone <12 mm), see flow chart below.</p> <p>2. Meropenem is the only carbapenem used for meningitis.</p> <p>3/E. The beta-lactamases produced by the organism either do not modify the parent carbapenem or are not affected by the inhibitor. Therefore the addition of the beta-lactamase inhibitor does not add clinical benefit.</p> <p>B. Read the outer edge of zones where an otherwise clear inhibition zone contains an area of growth around the disk, see pictures below.</p> <p>C. ATU relevant only if the benzylpenicillin 1 unit disk screen is positive (inhibition zone <12 mm).</p> <p>D. For benzylpenicillin 1 unit disk screen positive isolates (inhibition zone <12 mm), determine the MIC for meropenem.</p>
Ertapenem	0.5	0.5		10	23 ^{A,B}	23 ^{A,B}		
Imipenem	2	2		10	20 ^{A,B}	20 ^{A,B}	6-19 ^{B,C}	
Imipenem-relebactam ³	Note ³	Note ³			Note ^E	Note ^E		
Meropenem (indications other than meningitis)	2	2		10	20 ^{A,B}	20 ^{A,B}		
Meropenem (meningitis)	0.25	0.25			Note ^{A,D}	Note ^{A,D}		
Meropenem-vaborbactam ³	Note ³	Note ³			Note ^E	Note ^E		

Haemophilus influenzae
Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Monobactams	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Aztreonam	IE	IE			IE	IE		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Ciprofloxacin	0.06	0.06		5	30 ^A	30 ^A		A. The nalidixic acid disk diffusion test can be used to screen for fluoroquinolone resistance. See Note B. B. Isolates categorised as screen negative can be reported susceptible to ciprofloxacin, levofloxacin, moxifloxacin and ofloxacin. Isolates categorised as screen positive should be tested for susceptibility to individual agents <u>or reported resistant</u> .
Delafloxacin	IE	IE			IE	IE		
Levofloxacin	0.06	0.06		5	30 ^A	30 ^A		
Moxifloxacin	0.125	0.125		5	28 ^A	28 ^A		
Nalidixic acid (screen only)	NA	NA		30	23 ^B	23 ^B		
Norfloxacin (uncomplicated UTI only)	-	-			-	-		
Ofloxacin	0.06	0.06		5	30 ^A	30 ^A		

Aminoglycosides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Amikacin	IE	IE			IE	IE		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Gentamicin	IE	IE			IE	IE		
Netilmicin	IE	IE			IE	IE		
Tobramycin	IE	IE			IE	IE		

Glycopeptides and lipoglycopeptides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Dalbavancin	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Oritavancin	-	-			-	-		
Teicoplanin	-	-			-	-		
Telavancin	-	-			-	-		
Vancomycin	-	-			-	-		

Haemophilus influenzae

Expert Rules and Intrinsic Resistance Tables

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Macrolides ¹ , lincosamides and streptogramins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Azithromycin	Note ¹	Note ¹			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. Clinical evidence for the efficacy of macrolides in <i>H. influenzae</i> respiratory infections is conflicting due to high spontaneous cure rates. Should there be a need to test any macrolide against this species, the epidemiological cut-offs (ECOFFs) should be used to detect strains with acquired resistance. The ECOFFs for each agent are: azithromycin 4 mg/L, clarithromycin 32 mg/L, erythromycin 16 mg/L and telithromycin 8 mg/L. There are insufficient data available to establish an ECOFF for roxithromycin.</p>
Clarithromycin	Note ¹	Note ¹			Note ^A	Note ^A		
Erythromycin	Note ¹	Note ¹			Note ^A	Note ^A		
Roxithromycin	Note ¹	Note ¹			Note ^A	Note ^A		
Telithromycin	Note ¹	Note ¹			Note ^A	Note ^A		
Clindamycin	-	-			-	-		
Quinupristin-dalfopristin	-	-			-	-		

Tetracyclines	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doxycycline	1 ¹	2 ¹			Note ^A	Note ^A		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p> <p>1/A. Tetracycline can be used to screen for resistance in tetracycline agents. Isolates categorised as susceptible to tetracycline can be reported susceptible to doxycycline and minocycline. <u>Isolates categorised as resistant to tetracycline should be tested for susceptibility to individual agents or reported resistant.</u></p>
Eravacycline	IE	IE			IE	IE		
Minocycline	1 ¹	1 ¹		30	24 ^A	24 ^A		
Tetracycline	2 ¹	2 ¹		30	25 ^A	25 ^A		
Tigecycline	IE	IE			IE	IE		

Oxazolidinones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Linezolid	-	-			-	-		<p>Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.</p>
Tedizolid	-	-			-	-		

Haemophilus influenzae
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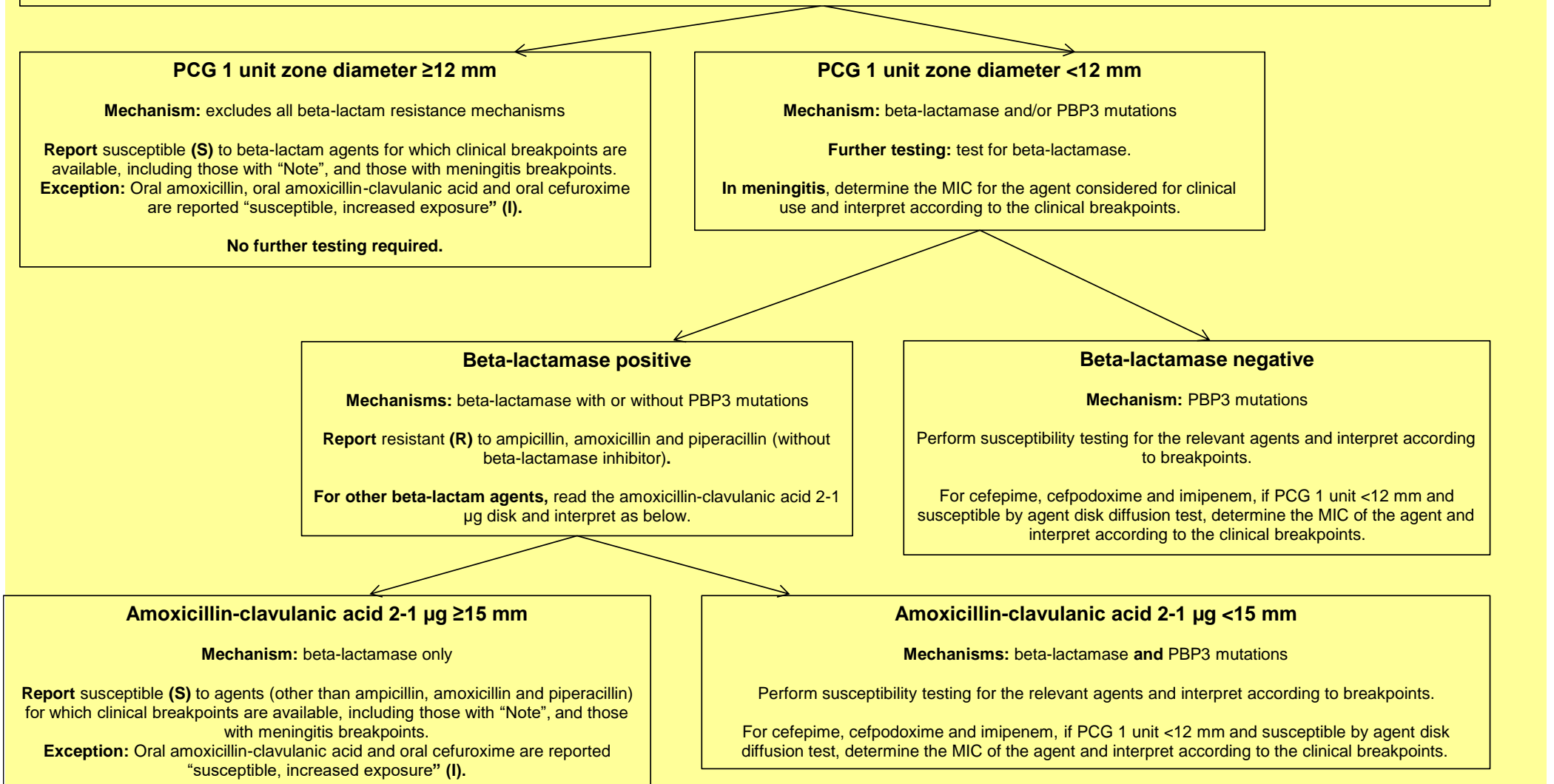
Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Chloramphenicol ¹	2	2		30	28	28		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. For chloramphenicol treatment in meningitis, see table of dosages. 2. Trimethoprim:sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration.
Colistin	-	-			-	-		
Daptomycin	-	-			-	-		
Fosfomycin iv	IE	IE			IE	IE		
Fosfomycin oral	-	-			-	-		
Fusidic acid	-	-			-	-		
Lefamulin	IE	IE			IE	IE		
Metronidazole	-	-			-	-		
Nitrofurantoin (uncomplicated UTI only)	-	-			-	-		
Nitroxoline (uncomplicated UTI only)	-	-			-	-		
Rifampicin (for prophylaxis only)	1	1		5	18	18		
Spectinomycin	-	-			-	-		
Trimethoprim (uncomplicated UTI only)	-	-			-	-		
Trimethoprim-sulfamethoxazole ²	0.5	1		1.25-23.75	23	20		



Examples of inhibition zones for *H. influenzae* and a beta-lactam agent where an otherwise clear inhibition zone contains an area of growth around the disk. Read the outer edge of zones where an otherwise clear inhibition zone contains an area of growth around the disk.

Haemophilus influenzae: Flow chart based on the benzylpenicillin (PCG) screen test for beta-lactam resistance mechanisms to reduce the number of specific tests for beta-lactam agents

To take full advantage of the procedure, include the amoxicillin-clavulanic acid 2-1 µg disk, but read and interpret only on beta-lactamase positive isolates.



Moraxella catarrhalis

Expert Rules and Intrinsic Resistance Tables

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An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

MIC determination (broth microdilution according to ISO standard 20776-1)

Medium: Mueller-Hinton broth + 5% lysed horse blood and 20 mg/L β -NAD (MH-F broth)

Inoculum: 5×10^5 CFU/mL

Incubation: Sealed panels, air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h

Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.

Quality control: *Haemophilus influenzae* ATCC 49766. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor combinations, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)

Medium: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β -NAD (MH-F)

Inoculum: McFarland 0.5

Incubation: 5% CO_2 , $35 \pm 1^\circ\text{C}$, 18 ± 2 h

Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.

Quality control: *Haemophilus influenzae* ATCC 49766. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor-combination disks, see EUCAST QC Tables.

Penicillins	MIC breakpoints (mg/L)			Disk content (μg)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Benzympenicillin	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. Most <i>M. catarrhalis</i> produce beta-lactamase, although beta-lactamase production is slow and may give weak results with <i>in vitro</i> tests. Beta-lactamase producers should be reported resistant to penicillins and aminopenicillins without inhibitors. 2. For susceptibility testing purposes, the concentration of sulbactam is fixed at 4 mg/L. 3/A. Susceptibility can be inferred from amoxicillin-clavulanic acid. 4. For susceptibility testing purposes, the concentration of clavulanic acid is fixed at 2 mg/L.
Ampicillin	≤ 1	≤ 1			-	-		
Ampicillin-sulbactam	$\leq 1^{2,3}$	$\leq 1^{2,3}$			Note ^A	Note ^A		
Amoxicillin	≤ 1	≤ 1			-	-		
Amoxicillin-clavulanic acid	≤ 4	≤ 4		2-1	19	19		
Piperacillin	≤ 1	≤ 1			-	-		
Piperacillin-tazobactam	Note ³	Note ³			Note ^A	Note ^A		
Ticarcillin	IE	IE			IE	IE		
Ticarcillin-clavulanic acid	IE	IE			IE	IE		
Temocillin	IE	IE			IE	IE		
Phenoxyethylpenicillin	-	-			-	-		
Oxacillin	-	-			-	-		
Cloxacillin	-	-			-	-		
Dicloxacillin	-	-			-	-		
Flucloxacillin	-	-			-	-		
Mecillinam oral (pivmecillinam) (uncomplicated UTI only)	-	-			-	-		

Moraxella catarrhalis

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

Cephalosporins	MIC breakpoints (mg/L)			Disk content (μ g)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S \leq	R >	ATU		S \geq	R <	ATU	
Cefaclor	-	-			-	-		
Cefadroxil	-	-			-	-		
Cefalexin	-	-			-	-		
Cefazolin	-	-			-	-		
Cefepime	4	4		30	20	20		
Cefiderocol	IE	IE			IE	IE		
Cefixime	0.5	1		5	21	18		
Cefotaxime	1	2		5	20	17		
Cefoxitin	IE	IE			IE	IE		
Cefpodoxime	IP	IP		10	IP	IP		
Ceftaroline	IE	IE			IE	IE		
Ceftazidime	-	-			-	-		
Ceftazidime-avibactam	-	-			-	-		
Ceftibuten	IE	IE			IE	IE		
Ceftobiprole	IE	IE			IE	IE		
Ceftolozane-tazobactam	IE	IE			IE	IE		
Ceftriaxone	1	2		30	24	21		
Cefuroxime iv	4	8		30	21	18		
Cefuroxime oral	0.001	4		30	50	21		

Carbapenems	MIC breakpoints (mg/L)			Disk content (μ g)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S \leq	R >	ATU		S \geq	R <	ATU	
Doripenem ¹	1	1		10	30	30		1. Resistant isolates are rare or not yet reported. The identification and antimicrobial susceptibility test result on any such isolate must be confirmed and the isolate sent to a reference laboratory. 2/A. The beta-lactamases produced by the organism either do not modify the parent carbapenem or are not affected by the inhibitor. Therefore the addition of the beta-lactamase inhibitor does not add clinical benefit.
Ertapenem ¹	0.5	0.5		10	29	29		
Imipenem ¹	2	2		10	29	29		
Imipenem-relebactam ²	Note ²	Note ²			Note ^A	Note ^A		
Meropenem ¹	2	2		10	33	33		
Meropenem-vaborbactam ²	Note ²	Note ²			Note ^A	Note ^A		

Monobactams	MIC breakpoints (mg/L)			Disk content (μ g)	Zone diameter breakpoints (mm)			Notes Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
	S \leq	R >	ATU		S \geq	R <	ATU	
Aztreonam	IE	IE			IE	IE		

Moraxella catarrhalis

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (μ g)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Ciprofloxacin	0.125	0.125		5	31 ^A	31 ^A		A. The nalidixic acid disk diffusion test can be used to screen for fluoroquinolone resistance. See Note B. B. Isolates categorised as screen negative can be reported susceptible to ciprofloxacin, levofloxacin, moxifloxacin and ofloxacin. Isolates categorised as screen positive should be tested for susceptibility to individual agents <u>or reported resistant</u> .
Delafloxacin	IE	IE			IE	IE		
Levofloxacin	0.125	0.125		5	29 ^A	29 ^A		
Moxifloxacin	0.25	0.25		5	26 ^A	26 ^A		
Nalidixic acid (screen only)	NA	NA		30	23 ^B	23 ^B		
Norfloxacin (uncomplicated UTI only)	-	-			-	-		
Ofloxacin	0.25	0.25		5	28 ^A	28 ^A		

Aminoglycosides	MIC breakpoints (mg/L)			Disk content (μ g)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Amikacin	IE	IE			IE	IE		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Gentamicin	IE	IE			IE	IE		
Netilmicin	IE	IE			IE	IE		
Tobramycin	IE	IE			IE	IE		

Glycopeptides and lipoglycopeptides	MIC breakpoints (mg/L)			Disk content (μ g)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Dalbavancin	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Oritavancin	-	-			-	-		
Teicoplanin	-	-			-	-		
Telavancin	-	-			-	-		
Vancomycin	-	-			-	-		

Macrolides, lincosamides and streptogramins	MIC breakpoints (mg/L)			Disk content (μ g)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Azithromycin	0.25 ¹	0.5 ¹			Note ^A	Note ^A		1/A. Erythromycin can be used to determine susceptibility to azithromycin, clarithromycin and roxithromycin.
Clarithromycin	0.25 ¹	0.5 ¹			Note ^A	Note ^A		
Erythromycin	0.25	0.5		15	23 ^A	20 ^A		
Roxithromycin	0.5 ¹	1 ¹			Note ^A	Note ^A		
Telithromycin	0.25	0.5		15	23	20		
Clindamycin	-	-			-	-		
Quinupristin-dalfopristin	-	-			-	-		

Moraxella catarrhalis

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An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

Tetracyclines	MIC breakpoints (mg/L)			Disk content (μ g)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Doxycycline	1 ¹	2 ¹			Note ^A	Note ^A		1/A. Tetracycline can be used to screen for resistance in tetracycline agents. Isolates categorised as susceptible to tetracycline can be reported susceptible to doxycycline and minocycline. Isolates categorised as resistant to tetracycline should be tested for susceptibility to individual agents or reported resistant.
Eravacycline	IE	IE			IE	IE		
Minocycline	1 ¹	1 ¹		30	25 ^A	25 ^A		
Tetracycline	2 ¹	2 ¹		30	26 ^A	26 ^A		
Tigecycline	IE	IE			IE	IE		

Oxazolidinones	MIC breakpoints (mg/L)			Disk content (μ g)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Linezolid	-	-			-	-		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Tedizolid	-	-			-	-		

Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (μ g)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Chloramphenicol	Note ¹	Note ¹			Note ^A	Note ^A		1/A. For topical use of chloramphenicol, see tables of topical agents. 2. Trimethoprim:sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration.
Colistin	-	-			-	-		
Daptomycin	-	-			-	-		
Fosfomycin iv	IE	IE			IE	IE		
Fosfomycin oral	-	-			-	-		
Fusidic acid	-	-			-	-		
Lefamulin	IE	IE			IE	IE		
Metronidazole	-	-			-	-		
Nitrofurantoin (uncomplicated UTI only)	-	-			-	-		
Nitroxoline (uncomplicated UTI only)	-	-			-	-		
Rifampicin	-	-			-	-		
Spectinomycin	-	-			-	-		
Trimethoprim (uncomplicated UTI only)	-	-			-	-		
Trimethoprim-sulfamethoxazole ²	0.5	1		1.25-23.75	18	15		

Neisseria gonorrhoeae

Expert Rules and Intrinsic Resistance Tables

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For comments on dosages related to breakpoints, see the table of dosages.

Disk diffusion criteria for antimicrobial susceptibility testing of *Neisseria gonorrhoeae* have not yet been defined and an MIC method should be used. If a commercial MIC method is used, follow the manufacturer's instructions. Laboratories with few isolates are encouraged to refer these to a reference laboratory for testing.

Penicillins ¹	MIC breakpoints (mg/L)			Notes
	S ≤	R >	ATU	
Benzylpenicillin (surrogate agent) ¹	0.06 ¹	1		1. Always test for beta-lactamase (tests based on a chromogenic cephalosporin can be used). If beta-lactamase positive, report resistant to ampicillin and amoxicillin. If beta-lactamase negative, determine the MIC of benzylpenicillin. Infer the susceptibility to ampicillin and amoxicillin from the benzylpenicillin MIC (do not report benzylpenicillin susceptibility).
Ampicillin ¹	Note ¹	Note ¹		
Ampicillin-sulbactam	IE	IE		
Amoxicillin ¹	Note ¹	Note ¹		
Amoxicillin-clavulanic acid	IE	IE		
Piperacillin	-	-		
Piperacillin-tazobactam	-	-		
Ticarcillin	-	-		
Ticarcillin-clavulanic acid	-	-		
Temocillin	IE	IE		
Phenoxymethylpenicillin	-	-		
Oxacillin	-	-		
Cloxacillin	-	-		
Dicloxacillin	-	-		
Flucloxacillin	-	-		
Mecillinam oral (pivmecillinam) (uncomplicated UTI only)	-	-		

Neisseria gonorrhoeae

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Cephalosporins	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Cefaclor	-	-		
Cefadroxil	-	-		
Cefalexin	-	-		
Cefazolin	-	-		
Cefepime	-	-		
Cefiderocol	IE	IE		
Cefixime	0.125	0.125		
Cefotaxime	0.125	0.125		
Cefoxitin	IE	IE		
Cefpodoxime	-	-		
Ceftaroline	-	-		
Ceftazidime	-	-		
Ceftazidime-avibactam	-	-		
Ceftibuten	-	-		
Ceftobiprole	-	-		
Ceftolozane-tazobactam	-	-		
Ceftriaxone	0.125	0.125		
Cefuroxime iv	-	-		
Cefuroxime oral	-	-		

Carbapenems	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Doripenem	IE	IE		
Ertapenem	IE	IE		
Imipenem	IE	IE		
Imipenem-relebactam	IE	IE		
Meropenem	IE	IE		
Meropenem-vaborbactam	IE	IE		

Monobactams	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Aztreonam	IE	IE		

Neisseria gonorrhoeae

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Fluoroquinolones	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Ciprofloxacin	0.03	0.06		
Delafloxacin	IE	IE		
Levofloxacin	IE	IE		
Moxifloxacin	IE	IE		
Nalidixic acid (screen only)	NA	NA		
Norfloxacin (uncomplicated UTI only)	-	-		
Ofloxacin	0.125	0.25		

Aminoglycosides	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Amikacin	-	-		
Gentamicin	-	-		
Netilmicin	-	-		
Tobramycin	-	-		

Glycopeptides and lipoglycopeptides	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Dalbavancin	-	-		
Oritavancin	-	-		
Teicoplanin	-	-		
Telavancin	-	-		
Vancomycin	-	-		

Macrolides, lincosamides and streptogramins	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Azithromycin	Note ¹	Note ¹		1. Azithromycin is always used in conjunction with another effective agent. For testing purposes with the aim of detecting acquired resistance mechanisms, the ECOFF is 1 mg/L.
Clarithromycin	-	-		
Erythromycin	-	-		
Roxithromycin	-	-		
Telithromycin	-	-		
Clindamycin	-	-		
Quinupristin-dalfopristin	-	-		

Neisseria gonorrhoeae

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Tetracyclines	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Doxycycline	IE	IE		
Eravacycline	IE	IE		
Minocycline	IE	IE		
Tetracycline	0.5	1		
Tigecycline	IE	IE		

Oxazolidinones	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Linezolid	-	-		
Tedizolid	-	-		

Miscellaneous agents	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Chloramphenicol	-	-		
Colistin	-	-		
Daptomycin	-	-		
Fosfomycin iv	-	-		
Fosfomycin oral	-	-		
Fusidic acid	-	-		
Lefamulin	IE	IE		
Metronidazole	-	-		
Nitrofurantoin (uncomplicated UTI only)	-	-		
Nitroxoline (uncomplicated UTI only)	-	-		
Rifampicin	-	-		
Spectinomycin	64	64		
Trimethoprim (uncomplicated UTI only)	-	-		
Trimethoprim-sulfamethoxazole	-	-		

Neisseria meningitidis

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Disk diffusion criteria for antimicrobial susceptibility testing of *Neisseria meningitidis* have not yet been defined and an MIC method should be used. If a commercial MIC method is used, follow the manufacturer's instructions.

Penicillins ¹	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Benzympenicillin (all indications)	0.25	0.25		1. All breakpoints pertain to iv administration.
Ampicillin (indications other than meningitis)	0.125	1		
Ampicillin (meningitis)	IE	IE		
Ampicillin-sulbactam	IE	IE		
Amoxicillin (indications other than meningitis)	0.125	1		
Amoxicillin (meningitis)	IE	IE		
Amoxicillin-clavulanic acid	-	-		
Piperacillin	-	-		
Piperacillin-tazobactam	-	-		
Ticarcillin	-	-		
Ticarcillin-clavulanic acid	-	-		
Temocillin	-	-		
Phenoxymethylpenicillin	-	-		
Oxacillin	-	-		
Cloxacillin	-	-		
Dicloxacillin	-	-		
Flucloxacillin	-	-		
Mecillinam oral (pivmecillinam) (uncomplicated UTI only)	-	-		

Neisseria meningitidis

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Cephalosporins	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Cefaclor	-	-		1. Resistant isolates are rare or not yet reported. The identification and antimicrobial susceptibility test result on any such isolate must be confirmed and the isolate sent to a reference laboratory.
Cefadroxil	-	-		
Cefalexin	-	-		
Cefazolin	-	-		
Cefepime	-	-		
Cefiderocol	IE	IE		
Cefixime	-	-		
Cefotaxime (all indications) ¹	0.125	0.125		
Cefoxitin	-	-		
Cefpodoxime	-	-		
Ceftaroline	-	-		
Ceftazidime	-	-		
Ceftazidime-avibactam	-	-		
Ceftibuten	-	-		
Ceftobiprole	-	-		
Ceftolozane-tazobactam	-	-		
Ceftriaxone (all indications including prophylaxis) ¹	0.125	0.125		
Cefuroxime iv	-	-		
Cefuroxime oral	-	-		

Carbapenems ^{1,2}	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Doripenem	Note ²	Note ²		1. Resistant isolates are rare or not yet reported. The identification and antimicrobial susceptibility test result on any such isolate must be confirmed and the isolate sent to a reference laboratory. 2. Breakpoints for serious <i>N. meningitidis</i> systemic infections (meningitis with or without septicemia) have been determined for meropenem only. The meningitis breakpoint can be used to categorise meropenem for other serious infections. 3. The beta-lactamases produced by the organism either do not modify the parent carbapenem or are not affected by the inhibitor. Therefore the addition of the beta-lactamase inhibitor does not add clinical benefit.
Ertapenem	IE	IE		
Imipenem	Note ²	Note ²		
Imipenem-relebactam ³	Note ^{2,3}	Note ^{2,3}		
Meropenem (indications other than meningitis)	Note ²	Note ²		
Meropenem (all indications) ^{1,2}	0.25	0.25		
Meropenem-vaborbactam ³	Note ^{2,3}	Note ^{2,3}		

Monobactams	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Aztreonam	-	-		

Neisseria meningitidis

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Fluoroquinolones	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Ciprofloxacin (prophylaxis only)	0.03	0.03		1. Breakpoints apply only to use in the prophylaxis of meningococcal disease.
Delafloxacin	IE	IE		
Levofloxacin	IE	IE		
Moxifloxacin	IE	IE		
Nalidixic acid (screen only)	NA	NA		
Norfloxacin (uncomplicated UTI only)	-	-		
Ofloxacin	IE	IE		

Aminoglycosides	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Amikacin	-	-		
Gentamicin	-	-		
Netilmicin	-	-		
Tobramycin	-	-		

Glycopeptides and lipoglycopeptides	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Dalbavancin	-	-		
Oritavancin	-	-		
Teicoplanin	-	-		
Telavancin	-	-		
Vancomycin	-	-		

Macrolides, lincosamides and streptogramins	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Azithromycin	-	-		
Clarithromycin	-	-		
Erythromycin	-	-		
Roxithromycin	-	-		
Telithromycin	-	-		
Clindamycin	-	-		
Quinupristin-dalfopristin	-	-		

Neisseria meningitidis

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Tetracyclines	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Doxycycline	-	-		1. Tetracycline can be used to predict susceptibility to minocycline for prophylaxis against <i>N. meningitidis</i> infections.
Eravacycline	IE	IE		
Minocycline (prophylaxis only)	1 ¹	1 ¹		
Tetracycline (screen only)	2 ¹	2 ¹		
Tigecycline	IE	IE		

Oxazolidinones	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Linezolid	-	-		
Tedizolid	-	-		

Miscellaneous agents	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Chloramphenicol (meningitis) ¹	2	2		1. For chloramphenicol treatment in meningitis, see table of dosages. 2. For prophylaxis of meningitis only (refer to national guidelines).
Colistin	-	-		
Daptomycin	-	-		
Fosfomycin iv	-	-		
Fosfomycin oral	-	-		
Fusidic acid	-	-		
Lefamulin	-	-		
Metronidazole	-	-		
Nitrofurantoin (uncomplicated UTI only)	-	-		
Nitroxoline (uncomplicated UTI only)	-	-		
Rifampicin (prophylaxis only)	0.25	0.25		
Spectinomycin	-	-		
Trimethoprim (uncomplicated UTI only)	-	-		
Trimethoprim-sulfamethoxazole	-	-		

Anaerobic bacteria

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

For species not listed below, see EUCAST Guidance Document on how to test and interpret results when there are no breakpoints
Expert Rules and Intrinsic Resistance Tables

MIC determination (agar dilution)

Medium: Fastidious Anaerobe Agar (FAA)

Inoculum: 10⁵ CFU/spot

Incubation: Anaerobic environment, 35-37°C, 48h

Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent where a noticeable difference is seen in visible growth between the test and control plate.

Quality control: *Bacteroides fragilis* ATCC 25285 and *Clostridium perfringens* ATCC 13124.

Clostridium perfringens. For control of the inhibitor component of beta-lactam inhibitor combinations, see EUCAST QC Tables.

Clostridium perfringens DSM 25589 with a metronidazole 5 µg disk to monitor the anaerobic atmosphere.

Disk diffusion (EUCAST standardised disk diffusion method)

Medium: Fastidious Anaerobe Agar (FAA). The plates should be dried prior to inoculation (at 20-25°C overnight or at 35°C, with the lid removed, for 15 min).

Inoculum: McFarland 1.0

Incubation: Anaerobic environment, 35-37°C, 18±2h

Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light. See pictures below and the EUCAST Reading Guide for disk diffusion of anaerobic bacteria for further information.

Quality control: *Bacteroides fragilis* ATCC 25285 and *Clostridium perfringens* ATCC 13124. For control of the inhibitor component of beta-lactam inhibitor combination disks, see EUCAST QC Tables

Clostridium perfringens DSM 25589 with a metronidazole 5 µg disk to monitor the anaerobic atmosphere.

Bacteroides spp.

Antimicrobial agent	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Piperacillin-tazobactam	8 ¹	8 ¹		30-6	20	20		1. For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L. 2/A. The meropenem zone diameter breakpoint will detect all <i>cfiA</i> gene mediated carbapenem resistance in <i>Bacteroides fragilis</i> . Some isolates with an MIC of 1 mg/L may harbour the <i>cfiA</i> gene. 3/B. For information on how to use breakpoints in brackets, see https://www.eucast.org/eucastguidancedocuments/ . C. Examine zones carefully for colonies within zones. Colonies should be taken into account when reading.
Piperacillin-tazobactam, <i>B. thetaiotaomicron</i>	IE	IE			IE	IE		
Meropenem	1 ²	1 ²		10	28 ^A	28 ^A		
Clindamycin	(4) ³	(4) ³		2	(10) ^{B,C}	(10) ^{B,C}		
Metronidazole	4	4		5	25	25		

Prevotella spp.

Antimicrobial agent	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin	0.5	0.5		1 unit	20	20		1. For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L. A. Examine zones carefully for colonies within zones. Colonies should be taken into account when reading.
Piperacillin-tazobactam	0.5 ¹	0.5 ¹		30-6	26	26		
Meropenem	0.25	0.25		10	34	34		
Clindamycin	0.25	0.25		2	31 ^A	31 ^A		
Metronidazole	4	4		5	22	22		

Anaerobic bacteria

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

For species not listed below, see EUCAST Guidance Document on how to test and interpret results when there are no breakpoints
Expert Rules and Intrinsic Resistance Tables

Fusobacterium necrophorum

Antimicrobial agent	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin	0.06	0.06		1 unit	25	25		1. For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L. A. Examine zones carefully for colonies within zones. Colonies should be taken into account when reading.
Piperacillin-tazobactam	0.5 ¹	0.5 ¹		30-6	32	32		
Meropenem	0.03	0.03		10	35	35		
Clindamycin	0.25	0.25		2	30 ^A	30 ^A		
Metronidazole	0.5	0.5		5	30	30		

Clostridium perfringens

Antimicrobial agent	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin	0.5	0.5		1 unit	15	15		1. For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L. A. Examine zones carefully for colonies within zones. Colonies should be taken into account when reading.
Piperacillin-tazobactam	0.5 ¹	0.5 ¹		30-6	24	24		
Meropenem	0.125	0.125		10	25	25		
Vancomycin	2	2		5	12	12		
Clindamycin	0.25	0.25		2	19 ^A	19 ^A		
Metronidazole	4	4		5	16	16		

Cutibacterium acnes

Antimicrobial agent	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin	0.06	0.06		1 unit	24	24		1. For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L. A. Examine zones carefully for colonies within zones. Colonies should be taken into account when reading.
Piperacillin-tazobactam	0.25 ¹	0.25 ¹		30-6	27	27		
Meropenem	0.125	0.125		10	28	28		
Vancomycin	2	2		5	22	22		
Clindamycin	0.25	0.25		2	26 ^A	26 ^A		

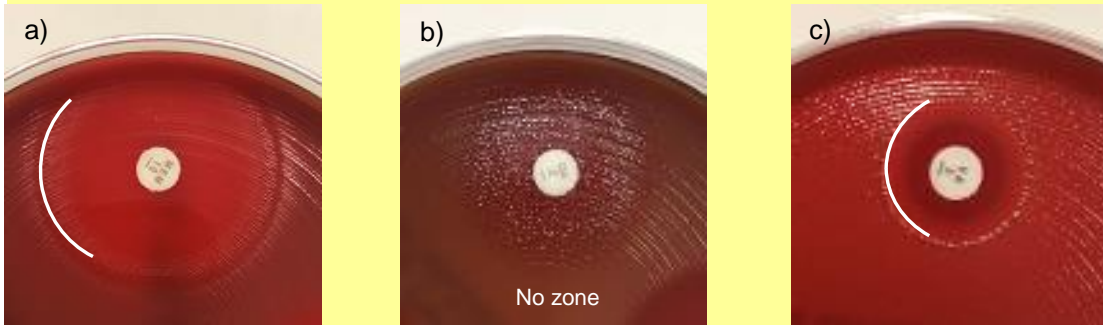
Anaerobic bacteria

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

For species not listed below, see EUCAST Guidance Document on how to test and interpret results when there are no breakpoints
Expert Rules and Intrinsic Resistance Tables

Clostridioides difficile

Antimicrobial agent	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Vancomycin	2 ¹	2 ¹			IP	IP		1 The breakpoints are based on epidemiological cut-off values (ECOFFs) and apply to oral treatment of <i>C. difficile</i> infections. There are no conclusive clinical data regarding the relation between MICs and outcomes. 2. Fidaxomicin breakpoints and ECOFF have not been set because the available data show major variation in MIC distributions between studies.
Fidaxomicin	IE ²	IE ²			IE	IE		
Metronidazole	2 ¹	2 ¹			IP	IP		



Examples of inhibition zones for anaerobic bacteria.

- If haze within the zone occurs, read the most obvious zone edge. Tilt the plate towards you to better define the obvious zone edge.
- Isolated colonies within the inhibition zone should be taken into account. For clindamycin, it is particularly important to examine zones carefully for colonies growing within the zone.
- Ignore haemolysis when reading zones.

Helicobacter pylori

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Disk diffusion criteria for antimicrobial susceptibility testing of *Helicobacter pylori* have not yet been defined and an MIC method should be used. If a commercial MIC method is used, follow the manufacturer's instructions.

Penicillins	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Amoxicillin oral	0.125	0.125		

Fluoroquinolones	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Levofloxacin	1	1		

Macrolides	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Clarithromycin	0.25	0.5		

Tetracyclines	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Tetracycline	1	1		

Miscellaneous agents	MIC breakpoints (mg/L)			Notes Numbered notes relate to general comments and/or MIC breakpoints.
	S ≤	R >	ATU	
Metronidazole	8	8		
Rifampicin	1	1		

Listeria monocytogenes

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

MIC determination (broth microdilution according to ISO standard 20776-1)
Medium: Mueller-Hinton broth + 5% lysed horse blood and 20 mg/L β-NAD (MH-F broth)
Inoculum: 5x10⁵ CFU/mL
Incubation: Sealed panels, air, 35±1°C, 18±2h
Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. [See "EUCAST Reading Guide for broth microdilution" for further information.](#)
Quality control: *Streptococcus pneumoniae* ATCC 49619. For agents not covered by this strain, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)
Medium: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β-NAD (MH-F)
Inoculum: McFarland 0.5
Incubation: 5% CO₂, 35±1°C, 18±2h
Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light. [See "EUCAST Reading Guide for disk diffusion" for further information.](#)
Quality control: *Streptococcus pneumoniae* ATCC 49619. For agents not covered by this strain, see EUCAST QC Tables.

Penicillins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin (indications other than meningitis)	1	1		1 unit	13	13		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Benzylpenicillin (meningitis)	IE	IE			IE	IE		
Ampicillin iv (all indications)	1	1		2	16	16		

Carbapenems	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Meropenem (all indications)	0.25	0.25		10	26	26		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Macrolides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Erythromycin (indications other than meningitis)	1	1		15	25	25		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Trimethoprim-sulfamethoxazole (all indications) ¹	0.06	0.06		1.25-23.75	29	29		1. Trimethoprim-sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration.

Pasteurella multocida

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

MIC determination (broth microdilution according to ISO standard 20776-1)
Medium: Mueller-Hinton broth + 5% lysed horse blood and 20 mg/L β-NAD (MH-F broth)
Inoculum: 5x10⁵ CFU/mL
Incubation: Sealed panels, air, 35±1°C, 18±2h
Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.
Quality control: *Haemophilus influenzae* ATCC 49766. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor combinations, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)
Medium: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β-NAD (MH-F)
Inoculum: McFarland 0.5
Incubation: 5% CO₂, 35±1°C, 18±2h
Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.
Quality control: *Haemophilus influenzae* ATCC 49766. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor-combination disks, see EUCAST QC Tables.

Penicillins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin	0.5	0.5		1 unit	17	17		1. For susceptibility testing purposes, the concentration of clavulanic acid is fixed at 2 mg/L. A. Infer susceptibility from benzylpenicillin susceptibility.
Ampicillin	1	1			Note ^A	Note ^A		
Amoxicillin	1	1			Note ^A	Note ^A		
Amoxicillin-clavulanic acid	1 ¹	1 ¹		2-1	15	15		

Cephalosporins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Cefotaxime	0.03	0.03		5	26	26		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Ciprofloxacin	0.06	0.06		5	27 ^A	27 ^A		A. The nalidixic acid disk diffusion test can be used to screen for fluoroquinolone resistance. See Note B. B. Isolates categorised as screen negative can be reported susceptible to ciprofloxacin and levofloxacin. Isolates categorised as screen positive should be tested for susceptibility to individual agents or reported resistant.
Levofloxacin	0.06	0.06		5	27 ^A	27 ^A		
Nalidixic acid (screen only)	NA	NA		30	23 ^B	23 ^B		

Pasteurella multocida

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Tetracyclines	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doxycycline	1	1			Note ^A	Note ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. A. Susceptibility to doxycycline can be inferred from the tetracycline disk diffusion screening test.
Tetracycline (screen only)	NA	NA		30	24 ^A	24 ^A		

Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Trimethoprim-sulfamethoxazole ¹	0.25	0.25		1.25-23.75	23	23		1. Trimethoprim-sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration.

Campylobacter jejuni* and *coli
Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

MIC determination (broth microdilution according to ISO standard 20776-1)
Medium: Mueller-Hinton broth + 5% lysed horse blood and 20 mg/L β -NAD (MH-F broth)
Inoculum: 5×10^5 CFU/mL
Incubation: Microaerobic environment, $41 \pm 1^\circ\text{C}$, 24h. Isolates with insufficient growth after 24h incubation are reincubated immediately and MICs read after a total of 40-48h incubation.
Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.
Quality control: *Staphylococcus aureus* ATCC 29213 (standard conditions for staphylococci)

Disk diffusion (EUCAST standardised disk diffusion method)
Medium: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β -NAD (MH-F). The MH-F plates should be dried prior to inoculation to reduce swarming (at 20-25°C overnight or at 35°C, with the lid removed, for 15 min).
Inoculum: McFarland 0.5
Incubation: Microaerobic environment, $41 \pm 1^\circ\text{C}$, 24h. Isolates with insufficient growth after 24h incubation are reincubated immediately and inhibition zones read after a total of 40-48h incubation.
Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.
Quality control: *Campylobacter jejuni* ATCC 33560

Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (μg)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Ciprofloxacin	0.001	0.5		5	50	26		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Macrolides	MIC breakpoints (mg/L)			Disk content (μg)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Azithromycin	Note ¹	Note ¹			Note ^A	Note ^A		1/A. Erythromycin can be used to determine susceptibility to azithromycin and clarithromycin.
Clarithromycin	Note ¹	Note ¹			Note ^A	Note ^A		
Erythromycin, <i>C. jejuni</i>	4 ¹	4 ¹		15	20 ^A	20 ^A		
Erythromycin, <i>C. coli</i>	8 ¹	8 ¹		15	24 ^A	24 ^A		

Tetracyclines	MIC breakpoints (mg/L)			Disk content (μg)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Doxycycline	Note ¹	Note ¹			Note ^A	Note ^A		1/A. Tetracycline can be used to determine susceptibility to doxycycline.
Tetracycline	2 ¹	2 ¹		30	30 ^A	30 ^A		

Corynebacterium spp.

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Breakpoints for corynebacteria were developed for species other than *C. diphtheriae*. In an ongoing study, the preliminary results indicate that the current breakpoints for benzylpenicillin and rifampicin are not useful for *C. diphtheriae*.

An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

MIC determination (broth microdilution according to ISO standard 20776-1)
Medium: Mueller-Hinton broth + 5% lysed horse blood and 20 mg/L β -NAD (MH-F broth)
Inoculum: 5×10^5 CFU/mL
Incubation: Sealed panels, air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h. Isolates with insufficient growth after 16-20h incubation are reincubated immediately and MICs read after a total of 40-44h incubation.
Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.
Quality control: *Streptococcus pneumoniae* ATCC 49619. For agents not covered by this strain, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)
Medium: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β -NAD (MH-F)
Inoculum: McFarland 0.5
Incubation: 5% CO_2 , $35 \pm 1^\circ\text{C}$, 18 ± 2 h. Isolates with insufficient growth after 16-20h incubation are reincubated immediately and inhibition zones read after a total of 40-44h incubation.
Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.
Quality control: *Streptococcus pneumoniae* ATCC 49619. For agents not covered by this strain, see EUCAST QC Tables.

Penicillins	MIC breakpoints (mg/L)			Disk content (μg)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Benzylpenicillin	0.125	0.125		1 unit	29	29		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (μg)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Ciprofloxacin	0.001	1		5	50	25		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Moxifloxacin	0.5	0.5		5	25	25		

Aminoglycosides	MIC breakpoints (mg/L)			Disk content (μg)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Gentamicin	IE	IE			IE	IE		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Glycopeptides	MIC breakpoints (mg/L)			Disk content (μg)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Vancomycin	2	2		5	17 ^A	17 ^A		A. Non-wild type isolates were not available when developing the disk diffusion method.

Corynebacterium spp.

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Macrolides and lincosamides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Erythromycin	IP	IP		15	IP	IP		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. Inducible clindamycin resistance may occur in <i>Corynebacteria</i> . This can be detected by antagonism of clindamycin activity by a macrolide agent. The clinical significance is unknown. There is currently no recommendation for testing.
Clindamycin ¹	0.5	0.5		2	20	20		

Tetracyclines	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Tetracycline	2	2		30	24	24		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Oxazolidinones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Linezolid	2	2		10	25	25		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Rifampicin	0.06	0.5		5	30	25		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Aerococcus sanguinicola and urinae

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

MIC determination (broth microdilution according to ISO standard 20776-1)¹
Medium: Mueller-Hinton broth + 5% lysed horse blood and 20 mg/L β-NAD (MH-F broth)
Inoculum: 5x10⁵ CFU/mL
Incubation: Sealed panels, air, 35±1°C, 18±2h. Isolates with insufficient growth after 16-20h incubation are reincubated immediately and MICs read after a total of 40-44h incubation.
Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.
Quality control: *Streptococcus pneumoniae* ATCC 49619. For agents not covered by this strain, see EUCAST QC Tables.
¹ For fluoroquinolones, agar dilution may produce clearer endpoints.

Disk diffusion (EUCAST standardised disk diffusion method)
Medium: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β-NAD (MH-F)
Inoculum: McFarland 0.5
Incubation: 5% CO₂, 35±1°C, 18±2h. Isolates with insufficient growth after 16-20h incubation are reincubated immediately and inhibition zones read after a total of 40-44h incubation.
Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.
Quality control: *Streptococcus pneumoniae* ATCC 49619. For agents not covered by this strain, see EUCAST QC Tables.

Penicillins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin	0.125	0.125		1 unit	21	21		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1/A. Infer susceptibility from ampicillin susceptibility.
Ampicillin	0.25	0.25		2	26	26		
Amoxicillin	Note ¹	Note ¹			Note ^A	Note ^A		

Carbapenems	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Meropenem	0.25	0.25		10	31	31		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Ciprofloxacin (uncomplicated UTI only)	2	2		5	21 ^A	21 ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. Susceptibility can be inferred from ciprofloxacin susceptibility. A. Susceptibility can be inferred from the norfloxacin disk diffusion screening test. See Note C. B. Susceptibility can be inferred from the ciprofloxacin susceptibility or the norfloxacin disk diffusion screening test. See Note C. C. The norfloxacin disk diffusion test can be used to screen for fluoroquinolone resistance.
Levofloxacin (uncomplicated UTI only)	2 ¹	2 ¹			Note ^B	Note ^B		
Norfloxacin (screen only)	NA	NA		10	17 ^C	17 ^C		

Aerococcus sanguinicola* and *urinae

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Glycopeptides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Vancomycin	1	1		5	16 ^A	16 ^A		A. Non-wild type isolates were not available when developing the disk diffusion method.

Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Nitrofurantoin (uncomplicated UTI only)	16	16		100	16	16		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Rifampicin	0.125	0.125		5	25	25		

Kingella kingae

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

MIC determination (broth microdilution according to ISO standard 20776-1)
Medium: Mueller-Hinton broth + 5% lysed horse blood and 20 mg/L β-NAD (MH-F broth)
Inoculum: 5x10⁵ CFU/mL
Incubation: Sealed panels, air, 35±1°C, 18±2h. Isolates with insufficient growth after 16-20h incubation are reincubated immediately and inhibition zones read after a total of 40-44h incubation.
Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.
Quality control: *Haemophilus influenzae* ATCC 49766. For agents not covered by this strain, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)
Medium: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β-NAD (MH-F)
Inoculum: McFarland 0.5
Incubation: 5% CO₂, 35±1°C, 18±2h. Isolates with insufficient growth after 16-20h incubation are reincubated immediately and inhibition zones read after a total of 40-44h incubation.
Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.
Quality control: *Haemophilus influenzae* ATCC 49766. For agents not covered by this strain, see EUCAST QC Tables.

Penicillins ¹	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Benzylpenicillin	0.03	0.03		1 unit	25	25		1. Beta-lactamase positive isolates can be reported resistant to benzylpenicillin and to ampicillin and amoxicillin without inhibitors. Tests based on a chromogenic cephalosporin can be used to detect the beta-lactamase. Beta-lactamase resistance mechanisms other than beta-lactamase production have not yet been described for <i>K. kingae</i> . 2. Susceptibility can be inferred from benzylpenicillin susceptibility. 3/B. The intrinsic activity of clavulanic acid in <i>K. kingae</i> is such that the organism is inhibited by 2 mg/L clavulanic acid. Therefore no breakpoints for amoxicillin-clavulanic acid can be given. A. Infer susceptibility from benzylpenicillin susceptibility.
Ampicillin	0.06 ²	0.06 ²			Note ^A	Note ^A		
Amoxicillin	0.125 ²	0.125 ²			Note ^A	Note ^A		
Amoxicillin-clavulanic acid	Note ³	Note ³			Note ^B	Note ^B		

Cephalosporins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Cefotaxime	0.125	0.125		5	27	27		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Ceftriaxone	0.06	0.06		30	30	30		
Cefuroxime iv	0.5	0.5		30	29	29		

Carbapenems	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Meropenem	0.03	0.03		10	30	30		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Ciprofloxacin	0.06	0.06		5	28	28		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Levofloxacin	0.125	0.125		5	28	28		

Kingella kingae

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Macrolides and lincosamides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Azithromycin	0.25 ¹	0.25 ¹			Note ^A	Note ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. Susceptibility can be inferred from erythromycin susceptibility. A. Infer susceptibility from erythromycin susceptibility.
Clarithromycin	0.5 ¹	0.5 ¹			Note ^A	Note ^A		
Erythromycin	0.5	0.5		15	20	20		
Clindamycin	-	-			-	-		

Tetracyclines	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doxycycline	0.5 ¹	0.5 ¹			Note ^A	Note ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1/A. Tetracycline can be used to screen for resistance in tetracycline agents. Isolates categorised as susceptible can be reported susceptible to doxycycline. Isolates categorised as resistant should be tested for susceptibility to doxycycline <u>or</u> reported resistant.
Tetracycline	0.5	0.5		30	28	28		

Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Rifampicin	0.5	0.5		5	20	20		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. Trimethoprim:sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration.
Trimethoprim-sulfamethoxazole ¹	0.25	0.25		1.25-23.75	28	28		

Aeromonas spp.

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

MIC determination (broth microdilution according to ISO standard 20776-1)

Medium: Mueller-Hinton broth

Inoculum: 5x10⁵ CFU/mL

Incubation: Sealed panels, air, 35±1°C, 18±2h

Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. [See "EUCAST Reading Guide for broth microdilution" for further information.](#)

Quality control: *Pseudomonas aeruginosa* ATCC 27853. For agents not covered by this strain, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)

Medium: Mueller-Hinton agar

Inoculum: McFarland 0.5

Incubation: Air, 35±1°C, 18±2h

Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light. [See "EUCAST Reading Guide for disk diffusion" for further information.](#)

Quality control: *Pseudomonas aeruginosa* ATCC 27853. For agents not covered by this strain, see EUCAST QC Tables.

Cephalosporins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Cefepime	1	4		30	27	24		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Ceftazidime	1	4		10	24	21		

Monobactams	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Aztreonam	1	4		30	29	26		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Ciprofloxacin	0.25	0.5		5	27	24		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Levofloxacin	0.5	1		5	27	24		

Aeromonas spp.

Expert Rules and Intrinsic Resistance Tables

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Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Trimethoprim-sulfamethoxazole ¹	2	4		1.25-23.75	19 ^A	16 ^A		1. Trimethoprim:sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration. A. Read the obvious zone edge and disregard haze or growth within the inhibition zone (see pictures below).



Examples of inhibition zones for *Aeromonas* spp. with trimethoprim-sulfamethoxazole.

a-c) Read the obvious zone edge and disregard haze or growth within the inhibition zone.

Achromobacter xylosoxidans
Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

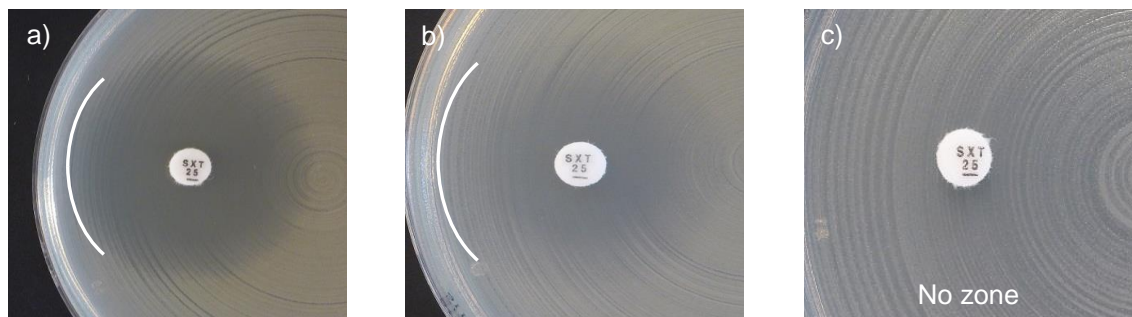
MIC determination (broth microdilution according to ISO standard 20776-1)
Medium: Mueller-Hinton broth
Inoculum: 5x10⁵ CFU/mL
Incubation: Sealed panels, air, 35±1°C, 18±2h
Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.
Quality control: *Pseudomonas aeruginosa* ATCC 27853. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor combinations, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)
Medium: Mueller-Hinton agar
Inoculum: McFarland 0.5
Incubation: Air, 35±1°C, 18±2h
Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.
Quality control: *Pseudomonas aeruginosa* ATCC 27853. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor combination disks, see EUCAST QC Tables.

Penicillins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Piperacillin-tazobactam	4 ¹	4 ¹		30-6	26	26		1. For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L.

Carbapenems	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Meropenem	1	4		10	26	20		

Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Trimethoprim-sulfamethoxazole ¹	0.125	0.125		1.25-23.75	26 ^A	26 ^A		1. Trimethoprim:sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration. A. There may be growth within the inhibition zone. The density of growth may vary from a fine haze to substantial growth (see pictures below). If any zone edge can be seen, ignore growth within the inhibition zone and read the zone diameter.



Examples of inhibition zones for *Achromobacter xylosoxidans* with trimethoprim-sulfamethoxazole.

- a-b) An outer zone can be seen. Read the outer zone edge and interpret according to the breakpoints.
- c) Growth up to the disk and no sign of inhibition zone. Report resistant.

Vibrio spp.

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Breakpoints are valid for *V. alginolyticus*, *V. cholerae*, *V. fluvialis*, *V. parahaemolyticus* and *V. vulnificus*.

MIC determination (broth microdilution according to ISO standard 20776-1)

Medium: Mueller-Hinton broth

Inoculum: 5x10⁵ CFU/mL

Incubation: Sealed panels, air, 35±1°C, 18±2h

Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.

Quality control: *Escherichia coli* ATCC 25922. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor combinations, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)

Medium: Mueller-Hinton agar

Inoculum: McFarland 0.5

Incubation: Air, 35±1°C, 18±2h

Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.

Quality control: *Escherichia coli* ATCC 25922. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor combination disks, see EUCAST QC Tables.

Penicillins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Piperacillin-tazobactam	1 [†]	1 [†]		30-6	26	26		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L.

Cephalosporins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Cefotaxime	0.25	0.25		5	21	21		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Cefotaxime, <i>V. fluvialis</i>	IE	IE			IE	IE		
Ceftazidime	1	1		10	22	22		

Carbapenems	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Meropenem	0.5	0.5		10	24	24		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Ciprofloxacin	0.25	0.25		5	23 ^A	23 ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. A. Susceptibility to ciprofloxacin and levofloxacin can be inferred from the pefloxacin disk diffusion screening test.
Levofloxacin	0.25	0.25		5	23 ^A	23 ^A		
Pefloxacin (screen only)	NA	NA		5	20 ^A	20 ^A		

Vibrio spp.

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Expert Rules and Intrinsic Resistance Tables

Macrolides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Azithromycin	4	4		15	16 ^A	16 ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. A. Susceptibility to azithromycin can be inferred from the erythromycin disk diffusion screening test.
Erythromycin (screen only)	NA	NA		15	12 ^A	12 ^A		
Tetracyclines	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doxycycline	0.5	0.5			Note ^A	Note ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. A. Susceptibility to doxycycline can be inferred from the tetracycline disk diffusion screening test.
Tetracycline (screen only)	NA	NA		30	20 ^A	20 ^A		
Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Trimethoprim-sulfamethoxazole ¹	0.5	0.5		1.25-23.75	18	18		1. Trimethoprim:sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration.

Bacillus spp.

except *B. anthracis*

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

MIC determination (broth microdilution according to ISO standard 20776-1)

Medium: Mueller-Hinton broth

Inoculum: 5×10^5 CFU/mL

Incubation: Sealed panels, air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h

Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.

Quality control: *Staphylococcus aureus* ATCC 29213. For agents not covered by this strain, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)

Medium: Mueller-Hinton agar

Inoculum: McFarland 0.5

Incubation: Air, $35 \pm 1^\circ\text{C}$, 18 ± 2 h

Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.

Quality control: *Staphylococcus aureus* ATCC 29213. For agents not covered by this strain, see EUCAST QC Tables.

This genus includes several species. The most frequent species belong to the *Bacillus cereus* complex (*B. cereus*, *B. thuringiensis*, *B. mycoides* and *B. weihenstephanensis*). The breakpoints are not validated for *Bacillus anthracis*.

Carbapenems	MIC breakpoints (mg/L)			Disk content (μg)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Imipenem	0.5	0.5		10	30	30		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Meropenem	0.25	0.25		10	25	25		

Fluoroquinolones	MIC breakpoints (mg/L)			Disk content (μg)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Ciprofloxacin	0.001	0.5		5	50 ^A	23 ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. A. The norfloxacin disk diffusion test can be used to screen for fluoroquinolone resistance. See Note B. B. Isolates categorised as screen negative can be reported "susceptible increased exposure" (I) to ciprofloxacin and levofloxacin. Isolates categorised as screen positive can be reported resistant to ciprofloxacin and levofloxacin.
Levofloxacin	0.001	1		5	50 ^A	23 ^A		
Norfloxacin (screen only)	NA	NA		10	21 ^B	21 ^B		

Glycopeptides	MIC breakpoints (mg/L)			Disk content (μg)	Zone diameter breakpoints (mm)			Notes
	S \leq	R >	ATU		S \geq	R <	ATU	
Vancomycin	2	2		5	10 ^A	10 ^A		A. Non-wild type isolates were not available when developing the disk diffusion method.

Bacillus spp.except *B. anthracis***Expert Rules and Intrinsic Resistance Tables**

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Macrolides and lincosamides	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Erythromycin	0.5	0.5		15	24	24		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Clindamycin	1	1		2	17	17		

Oxazolidinones	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Linezolid	2	2		10	22	22		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

Burkholderia pseudomallei
Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

An MIC breakpoint of $S \leq 0.001$ mg/L is an arbitrary, "off scale" breakpoint (corresponding to a zone diameter breakpoint of " $S \geq 50$ mm") which categorises wild-type organisms (organisms without phenotypically detectable resistance mechanisms to the agent) as "Susceptible, increased exposure" (I). For these organism-agent combinations, never report "Susceptible, standard dosing regimen" (S).

MIC determination (broth microdilution according to ISO standard 20776-1)
Medium: Mueller-Hinton broth
Inoculum: 5×10^5 CFU/mL
Incubation: Sealed panels, air, $35 \pm 1^\circ\text{C}$, 18±2h
Reading: Unless otherwise stated, read MICs at the lowest concentration of the agent that completely inhibits visible growth. See "EUCAST Reading Guide for broth microdilution" for further information.
Quality control: *Escherichia coli* ATCC 25922. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor combinations, see EUCAST QC Tables.

Disk diffusion (EUCAST standardised disk diffusion method)
Medium: Mueller-Hinton agar
Inoculum: McFarland 0.5
Incubation: Air, $35 \pm 1^\circ\text{C}$, 18±2h
Reading: Unless otherwise stated, read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light. See "EUCAST Reading Guide for disk diffusion" for further information.
Quality control: *Escherichia coli* ATCC 25922. For agents not covered by this strain and for control of the inhibitor component of beta-lactam inhibitor combination disks, see EUCAST QC Tables.

Penicillins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Amoxicillin-clavulanic acid	0.001 ¹	8 ¹		20-10	50	22		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. 1. For susceptibility testing purposes, the concentration of clavulanic acid is fixed at 2 mg/L.

Cephalosporins	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Ceftazidime	0.001	8		10	50	18		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.

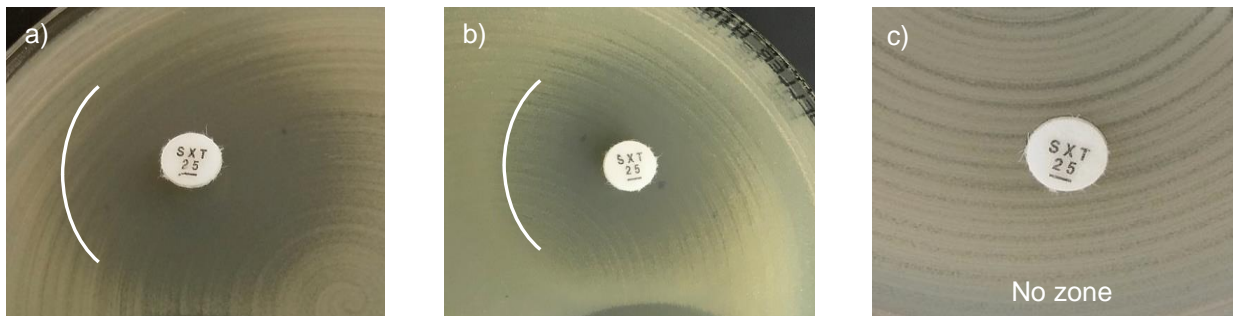
Carbapenems	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Imipenem	2	2		10	29	29		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method.
Meropenem	2	2		10	24	24		

Tetracyclines	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Doxycycline	0.001	2			Note ^A	Note ^A		Numbered notes relate to general comments and/or MIC breakpoints. Lettered notes relate to the disk diffusion method. A. Isolates categorised as screen negative can be reported "susceptible increased exposure" (I) to doxycycline. Isolates categorised as screen positive can be reported resistant to doxycycline.
Tetracycline (screen only)	NA	NA		30	23 ^A	23 ^A		

Burkholderia pseudomallei
Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Miscellaneous agents	MIC breakpoints (mg/L)			Disk content (µg)	Zone diameter breakpoints (mm)			Notes
	S ≤	R >	ATU		S ≥	R <	ATU	
Chloramphenicol	0.001	8		30	50	22		1. Trimethoprim:sulfamethoxazole in the ratio 1:19. Breakpoints are expressed as the trimethoprim concentration. A. There may be growth within the inhibition zone. The density of growth may vary from a fine haze to substantial growth (see pictures below). If any zone edge can be seen, ignore growth within the inhibition zone and read the zone diameter.
Trimethoprim-sulfamethoxazole ¹	0.001	4		1.25-23.75	50 ^A	17 ^A		



Examples of inhibition zones for *Burkholderia pseudomallei* with trimethoprim-sulfamethoxazole.

a-b) An outer zone can be seen. Read the outer zone edge and interpret according to the breakpoints.

c) Growth up to the disk **and** no sign of inhibition zone. Report resistant.

***Burkholderia cepacia* complex**

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

EUCAST has not determined breakpoints for *Burkholderia cepacia* complex organisms since accurate and reproducible methods for antimicrobial susceptibility testing are lacking due to technical difficulties encountered with these species and the lack of convincing clinical outcome correlates.

[Users are referred to the EUCAST Guidance Document on *Burkholderia cepacia* complex.](#)

Burkholderia cepacia complex currently includes at least 21 closely related species: *B. ambifaria* (genomovar VII), *B. anthina* (genomovar VIII), *B. arboris* (BCC3), *B. cepacia* (genomovar I), *B. cenocepacia* (genomovar III), *B. contaminans* (group K, BBC AT), *B. diffusa* (BCC2), *B. dolosa* (genomovar VI), *B. lata* (group K), *B. latens* (BCC1), *B. metallica* (BCC8), *B. multivorans* (genomovar II), *B. paludis*, *B. pseudomultivorans*, *B. pyrrocinia* (genomovar IX), *B. seminalis* (BCC7), *B. stabilis* (genomovar IV), *B. stagnalis* (BCC B), *B. territorii* (BCC L), *B. ubonensis* (genomovar X), *B. vietnamiensis* (genomovar V).

Legionella pneumophila

Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

EUCAST has not determined breakpoints for *Legionella pneumophila* as there is no established reference method or any documentation of clinical outcome related to antimicrobial susceptibility testing.

[Users are referred to the EUCAST Guidance Document on *Legionella pneumophila* susceptibility testing.](#)

Mycobacterium tuberculosis
Expert Rules and Intrinsic Resistance Tables

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Listed breakpoints have been set in parallel with marketing authorisation by EMA. Breakpoints for other agents have not yet been established. Infections with *M. tuberculosis* are always treated with two or more agents.

MIC determination using broth microdilution according to the EUCAST reference method for the *Mycobacterium tuberculosis* complex

Medium: Middlebrook 7H9 with 10% OADC in polystyrene plates

Inoculum: 1x10⁵ CFU/mL

Incubation: Plates sealed with a plastic lid, air, 36±1°C, 7-21 days

Reading: At the earliest time point (7, 14 or 21 days) when the 1% growth control shows visible growth, read MICs at the lowest concentration of the agent that completely inhibits visible growth

Quality control: *Mycobacterium tuberculosis* H37Rv ATCC 27294

The *Mycobacterium tuberculosis* complex includes different species and variants such as *M. tuberculosis* var. *tuberculosis*, *M. tuberculosis* var. *africanum* and *M. tuberculosis* var. *bovis*. Breakpoints have only been established for *M. tuberculosis* var. *tuberculosis*.

Antimicrobial agent	MIC breakpoints (mg/L)			Notes
	S ≤	R >	ATU	
Bedaquiline	0.25 ¹	0.25 ¹		1. Breakpoints were determined on MICs performed on Middlebrook 7H11/7H10 medium. The comparability of tests performed by other media has not been established. There is ongoing work to review breakpoints using the EUCAST reference method (described above). 2. MIC data have been generated with MGIT system and not with the EUCAST reference method. Therefore, it has not been possible to set an ECOFF, nor calibrate MGIT MIC values against the reference method. Consequently, EUCAST cannot endorse the tentative breakpoint set by EMA based on the MGIT method. Breakpoints are pending MIC data with the reference method.
Delamanid	0.06	0.06		
Pretomanid	IE ²	IE ²		

Topical agents

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Screening cut-off values for detection of phenotypic resistance

In the absence of clinical data on outcome related to MIC of infecting organisms EUCAST has not been able to determine relevant clinical breakpoints for topical use of antimicrobial agents. Laboratories are advised to either use the regular breakpoints or the cut-off values listed below to distinguish between organisms without and with acquired resistance mechanisms (for further details see EUCAST Guidance Document on www.eucast.org). When reporting the susceptibility of agents for topical use, clarify that results refer to topical use only.

Organisms	Screening cut-off values for the detection and reporting of phenotypic resistance. Report resistant (R) for isolates with MIC above or inhibition zone diameter below the cut-off value. Otherwise report susceptible (S).	Gentamicin	Tobramycin	Pefloxacin (screen only) ¹	Norfloxacin (screen only) ¹	Nalidixic acid (screen only) ¹	Ciprofloxacin	Levofloxacin	Ofloxacin	Chloramphenicol	Colistin (for polymyxin B)	Fusidic acid	Neomycin (framycetin)	Bacitracin	Mupirocin	Retapamulin
		Disk content (µg)	10	10	5	10	30	5	5	5	30	-	10	10	-	200
<i>Enterobacterales</i>	MIC (mg/L)	2	2	-	-	-	0.125	0.25	0.25	16	2	-	8	-	-	-
	Zone diameter (mm)	17	16	24	-	-	Note ¹	Note ¹	Note ¹	17	-	-	12	-	-	-
<i>P. aeruginosa</i>	MIC (mg/L)	8	2	-	-	-	0.5	2	2	ND	4	-	ND	-	-	-
	Zone diameter (mm)	15	18	-	-	-	26	18	ND	ND	-	-	ND	-	-	-
<i>Acinetobacter</i> spp.	MIC (mg/L)	4	4	-	-	-	1	0.5	1	ND	2	-	ND	-	-	-
	Zone diameter (mm)	17	17	-	-	-	21	23	ND	ND	-	-	ND	-	-	-
<i>S. aureus</i>	MIC (mg/L)	2	2	-	-	-	1	0.5	1	16	-	0.5	1	ND	1 ²	0.5
	Zone diameter (mm)	18	18	-	17	-	Note ¹	Note ¹	Note ¹	18	-	24	14	ND	30 ²	ND
<i>S. pneumoniae</i>	MIC (mg/L)	-	-	-	-	-	4	2	4	8	-	ND	-	ND	-	-
	Zone diameter (mm)	-	-	-	10	-	Note ¹	Note ¹	Note ¹	21	-	ND	-	ND	-	-
Streptococcus groups A, B, C and G	MIC (mg/L)	-	-	-	-	-	2	2	4	8	-	32	-	ND	0.5	0.125
	Zone diameter (mm)	-	-	-	12	-	Note ¹	Note ¹	Note ¹	21	-	ND	-	ND	ND	ND
<i>H. influenzae</i>	MIC (mg/L)	4	8	-	-	-	0.06	0.06	0.06	2	-	ND	ND	-	-	-
	Zone diameter (mm)	ND	ND	-	-	23	Note ¹	Note ¹	Note ¹	28	-	ND	ND	-	-	-
<i>M. catarrhalis</i>	MIC (mg/L)	ND	ND	-	-	-	0.125	0.125	0.25	2	-	ND	ND	-	-	-
	Zone diameter (mm)	ND	ND	-	-	23	Note ¹	Note ¹	Note ¹	31	-	ND	ND	-	-	-

Notes

1. Screening agent for detection of fluoroquinolone resistance (pefloxacin for *Enterobacterales*, norfloxacin for gram positive organisms and nalidixic acid for *H. influenzae* and *M. catarrhalis*).

2. Breakpoints for nasal decontamination S ≤1, R >256 mg/L (S ≥30, R <18 mm for the mupirocin 200 µg disk). Isolates in the I category are associated with short term suppression (useful preoperatively) but, unlike fully susceptible isolates, long term eradication rates are low.

ND = No ECOFF available.

PK-PD (Non-species related) breakpoints

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

These breakpoints are used only when there are no species-specific breakpoints or other recommendations (a dash or a note) in the species-specific tables.

If the MIC is greater than the PK-PD resistant breakpoint, advise against use of the agent.

If the MIC is less than or equal to the PK-PD susceptible breakpoint, suggest that the agent can be used with caution. The MIC may also be reported although this is not essential. Include a note that the guidance is based on PK-PD breakpoints only, and include the dosage on which PK-PD breakpoint is based.

[More information is available in the EUCAST Guidance Document on how to test and interpret results when there are no breakpoints.](#)

Penicillins	MIC breakpoints (mg/L)		Notes
	S ≤	R >	
Benzylpenicillin	0.25	2	1. For susceptibility testing purposes, the concentration of sulbactam is fixed at 4 mg/L. 2. For susceptibility testing purposes, the concentration of clavulanic acid is fixed at 2 mg/L. 3. For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L.
Ampicillin	2	8	
Ampicillin-sulbactam	2 ¹	8 ¹	
Amoxicillin	2	8	
Amoxicillin-clavulanic acid	2 ²	8 ²	
Piperacillin	8	16	
Piperacillin-tazobactam	8 ³	16 ³	
Ticarcillin	8	16	
Ticarcillin-clavulanic acid	8 ²	16 ²	
Temocillin	8	8	
Phenoxyethylpenicillin	IE	IE	
Oxacillin	IE	IE	
Cloxacillin	IE	IE	
Dicloxacillin	IE	IE	
Flucloxacillin	IE	IE	
Mecillinam oral (pivmecillinam) (uncomplicated UTI only)	IE	IE	

PK-PD (Non-species related) breakpoints

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Cephalosporins	MIC breakpoints (mg/L)		Notes
	S ≤	R >	
Cefaclor	IE	IE	1. Broth microdilution MIC determination must be performed in iron-depleted Mueller-Hinton broth and specific reading instructions must be followed. For testing conditions and reading instructions, see http://www.eucast.org/guidance_documents/ . 2. Based on PK-PD target for Gram-negative organisms. 3. For susceptibility testing purposes, the concentration of avibactam is fixed at 4 mg/L. 4. Breakpoints are based on ceftolozane data. 5. For susceptibility testing purposes, the concentration of tazobactam is fixed at 4 mg/L.
Cefadroxil	IE	IE	
Cefalexin	IE	IE	
Cefazolin	1	2	
Cefepime	4	8	
Cefiderocol	2 ¹	2 ¹	
Cefixime	IE	IE	
Cefotaxime	1	2	
Cefoxitin	IE	IE	
Cefpodoxime	IE	IE	
Ceftaroline	0.5 ²	0.5 ²	
Ceftazidime	4	8	
Ceftazidime-avibactam	8 ³	8 ³	
Ceftibuten	IE	IE	
Ceftobiprole	4	4	
Ceftolozane-tazobactam	4 ^{4,5}	4 ^{4,5}	
Ceftriaxone	1	2	
Cefuroxime iv	4	8	
Cefuroxime oral	IE	IE	

Carbapenems	MIC breakpoints (mg/L)		Notes
	S ≤	R >	
Doripenem	1	2	1. For susceptibility testing purposes, the concentration of relebactam is fixed at 4 mg/L. 2. For susceptibility testing purposes, the concentration of vaborbactam is fixed at 8 mg/L.
Ertapenem	0.5	0.5	
Imipenem	2	4	
Imipenem-relebactam	2 ¹	2 ¹	
Meropenem	2	8	
Meropenem-vaborbactam	8 ²	8 ²	

Monobactams	MIC breakpoints (mg/L)		Notes
	S ≤	R >	
Aztreonam	4	8	

PK-PD (Non-species related) breakpoints

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Fluoroquinolones	MIC breakpoints (mg/L)		Notes
	S ≤	R >	
Ciprofloxacin	0.25	0.5	
Delafloxacin	IE	IE	
Levofloxacin	0.5	1	
Moxifloxacin	0.25	0.25	
Nalidixic acid (screen only)	IE	IE	
Norfloxacin	IE	IE	
Ofloxacin	0.25	0.5	

Aminoglycosides	MIC breakpoints (mg/L)		Notes
	S ≤	R >	
Amikacin	1	1	
Gentamicin	0.5	0.5	
Netilmicin	IE	IE	
Tobramycin	0.5	0.5	

Glycopeptides and lipoglycopeptides	MIC breakpoints (mg/L)		Notes
	S ≤	R >	
Dalbavancin	0.25 ¹	0.25 ¹	1. For broth microdilution MIC determination, the medium must be supplemented with polysorbate-80 to a final concentration of 0.002%. 2. PK-PD breakpoints are based on <i>S. aureus</i> . For <i>S. pyogenes</i> there is uncertainty regarding the PK-PD target.
Oritavancin	IE	IE	
Teicoplanin	IE	IE	
Telavancin	IE	IE	
Vancomycin	IE	IE	

Macrolides, lincosamides and streptogramins	MIC breakpoints (mg/L)		Notes
	S ≤	R >	
Azithromycin	IE	IE	
Clarithromycin	IE	IE	
Erythromycin	IE	IE	
Roxithromycin	IE	IE	
Telithromycin	IE	IE	
Clindamycin	IE	IE	
Quinupristin-dalfopristin	IE	IE	

PK-PD (Non-species related) breakpoints

EUCAST Clinical Breakpoint Tables v. 12.0, valid from 2022-01-01

Tetracyclines	MIC breakpoints (mg/L)		Notes
	S ≤	R >	
Doxycycline	IE	IE	1. For tigecycline broth microdilution MIC determination, the medium must be prepared fresh on the day of use.
Eravacycline	IE	IE	
Minocycline	IE	IE	
Tetracycline	IE	IE	
Tigecycline	0.5 ¹	0.5 ¹	

Oxazolidinones	MIC breakpoints (mg/L)		Notes
	S ≤	R >	
Linezolid	2	2	
Tedizolid	IE	IE	

Miscellaneous agents	MIC breakpoints (mg/L)		Notes
	S ≤	R >	
Chloramphenicol	IE	IE	
Colistin	IE	IE	
Daptomycin	IE	IE	
Fosfomycin iv	IE	IE	
Fosfomycin oral	8	8	
Fusidic acid	IE	IE	
Lefamulin	0.25	0.25	
Metronidazole	IE	IE	
Nitrofurantoin	IE	IE	
Nitroxoline	IE	IE	
Rifampicin	IE	IE	
Spectinomycin	IE	IE	
Trimethoprim	IE	IE	
Trimethoprim-sulfamethoxazole	IE	IE	